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Wastewater Treatment Facilities-Sludge Management System, Albuquerque, New Mexico

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Washington, DC

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United States
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Region 6
1201 Elm Street
Dallas TX 75270

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Water

EPA

Environmental Impact Statement

Supplemental Draft

Wastewater Treatment Facilities–Sludge Management System Albuquerque, New Mexico

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The City of Albuquerque proposes a sludge management system consisting of sludge thickening and stabilization units at Treatment Plant No. 2, followed by transfer of sludge via pipeline to Montesa Park where the sludge will be mechanically dewatered, dried in a solar greenhouse, disinfected by irradiation with Cesium-137, and disposed by landspreading on public lands. EPA has evaluated the City's proposal and 13 additional alternatives. Major concerns affecting EPA's decision whether to approve and fund a sludge management system are impacts of alternatives on environmental health and the overall costs.

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Wastewater Treatment Facilities–Sludge Management System Albuquerque, New Mexico

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

September 25, 1981

TO ALL INTERESTED AGENCIES, OFFICIALS, PUBLIC GROUPS AND INDIVIDUALS:

Enclosed is a copy of the Draft Supplemental Environmental Impact Statement (EIS) on the awarding of additional grants under Section 201 of the Clean Water Act for the design and construction of a sludge management system for the city of Albuquerque, Bernalillo County, New Mexico. This document has been prepared in compliance with the National Environmental Policy Act of 1969 and implementing regulations.

EPA and the city of Albuquerque will hold a public hearing on the Draft Supplemental EIS and facilities plan amendment at 7:00 p.m., Wednesday, November 18, 1981 in the Council Chambers, First Floor, City Hall, 400 Marquette N.W., Albuquerque, New Mexico. I request that individuals and representatives of groups wishing to make a statement at the hearing submit a written copy of their proposed statement at the time of the hearing, if possible. Witnesses should limit their testimony to a five minute summary of their written statement.

Comments on the Draft Supplemental EIS will be considered in the preparation of the Final Supplemental EIS. If the required changes are minor, EPA's Final Supplemental EIS will incorporate the Draft Supplemental by reference and include only: (1) a revised summary, (2) revisions necessary as a result of public comment and (3) EPA's response to comments made on the Draft Supplemental EIS. Therefore, the Draft Supplemental EIS should be retained for possible use in conjunction with the Final publication.

In cases where persons requested only a copy of the summary of the Draft Supplemental EIS, this transmittal letter accompanies that summary.

EPA's Final EIS for Albuquerque Wastewater Treatment Facilities dated August 1977, which is supplemented by the enclosed, and the city of Albuquerque's facilities plan amendment may be reviewed at the following locations:

1. Albuquerque Public Library
   Main Branch
   501 Cooper N.W.
   Albuquerque, New Mexico

2. Prospect Park Branch Library
   8205 Apache N.E.
   Albuquerque, New Mexico

4. Esperanza Branch Public Library
   5600 Esperanza N.W.
   Albuquerque, New Mexico

5. Los Griegos Branch Public Library
   1000 Griegos N.W.
   Albuquerque, New Mexico

3. Zimmerman Library
University of New Mexico
Government Publication Department
Albuquerque, New Mexico

6. Albuquerque Wastewater Treatment
Plant No. 2
North Street S.W.
Albuquerque, New Mexico

Written comments or inquiries regarding this EIS should be addressed to Mr. Clinton B. Spotts, Regional EIS Coordinator, at the above address by the date stamped on the cover sheet following this letter.

Sincerely,

Frances E. Phillips

Frances E. Phillips
Acting Regional Administrator

Enclosure

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
CITY OF ALBUQUERQUE, NEW MEXICO
SLUDGE MANAGEMENT SYSTEM

Responsible Agency: US Environmental Protection Agency Region 6 (EPA)

Cooperating Agencies: USDA Soil Conservation Service; US Department of Energy

Administrative Action: Awarding of Step II and Step III Construction Grants to the City of Albuquerque for the detailed design and construction of a sludge management system.

Contact for Further Information:

Clinton B. Spotts, Regional EIS Coordinator
US Environmental Protection Agency (6ASAF)
1201 Elm Street
Dallas, Texas 75270
(214) 767-2716 or FTS 729-2716

Comments on the Draft Supplemental EIS Due:

Abstract: The City of Albuquerque proposes a sludge management system consisting of sludge thickening and stabilization units at Treatment Plant No. 2, followed by transfer of sludge via pipeline to Montesa Park where the sludge will be mechanically dewatered, dried in a solar greenhouse, disinfected by irradiation with Cesium-137, and disposed by landspreading on public lands. EPA has evaluated the City's proposal and 13 additional alternatives. Major concerns affecting EPA's decision whether to approve and fund a sludge management system are impacts of alternatives on environmental health and the overall costs.

Responsible Official

Frances E. Phillips

Frances E. Phillips
Acting Regional Administrator

CHAPTER 1.0

SUMMARY

1.0 SUMMARY

1.1 DESCRIPTION OF ADMINISTRATIVE ACTION

The National Environmental Policy Act (NEPA) stipulates that each Federal agency shall " . . . include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on the environmental impact of the proposed action; any adverse environmental effects which cannot be avoided should the proposal be implemented; and alternatives to the proposed action . . ." This legislation is the basic framework for the Environmental Impact Statement (EIS).

One of the major EPA programs involving actions that may require an EIS is the Construction Grants Program, as authorized by Title II -- "Grants for Construction of Treatment Works," Section 201 (g) (1), of the Federal Water Pollution Control Act Amendments of 1972 (FWPCA), Public Law 92-500. This law authorizes the Administrator of USEPA, " . . . to make grants to any State, municipality, or intermunicipal or interstate agency for construction of publicly-owned treatment works . . . " Major provisional changes were made to the FWPCA in the Clean Water Act of 1977 (CWA), Public Law 95-217. Many of the changes are directed toward emerging public philosophies, and address concerns about chemical pollution, resource conservation, resource recovery and recycling, and environmentally compatible treatment systems. Key provisions of the CWA that directly affect the construction grants program include:

- Municipalities are required to consider alternative or innovative systems that provide for reclaiming, reuse, or recycling of wastewater; elimination of discharges; and recovery of energy. As an incentive for increased utilization of these systems, EPA will provide 85% of the funds for alternative or innovative systems, as opposed to 75% for conventional systems, and will pay 100% of the cost of rebuilding or modifying an alternative or innovative system that fails to meet its permit conditions or shows higher operation and management (O&M) costs.
- EPA will provide a 15% "cost effective bonus" for alternative or innovative systems when compared in a cost-effectiveness analysis for conventional technologies.

- Applicants for grant funds must analyze methods, processes, and techniques to reduce total energy consumption and to increase the open space and public recreation potential of lands, waters, and rights-of-way that are parts of a proposed project.
- The objectives of the CWA for sewage sludge management are to ensure protection of public health and the environment by promulgation of minimum Federal standards for sludge disposal and utilization and to maximize beneficial uses of sludges that conform to Federal standards.

The principal technical planning document for wastewater collection and treatment in the City of Albuquerque, New Mexico, and several outlying areas is the Final Albuquerque Areawide Wastewater Collection and Treatment Facilities Plan, which was prepared by the City of Albuquerque under the requirements of the CWA, and funded by EPA as Grant No. C-35-1020-01 under the construction grants program. Since the awarding of additional grants for design and construction of any wastewater treatment facilities had the potential for significant impact(s) to the natural and human environment, EPA determined that preparation of an environmental impact statement (EIS) was necessary. This EIS was prepared simultaneously with the preparation of the areawide facilities plan. Draft and Final EISs were published during June and August 1977, respectively.

On 27 September 1978, EPA published in the Federal Register the final regulations concerning Federal grants for the construction of treatment works. These final regulations implemented the previously mentioned significant changes in the FWPCA, as caused by the CWA. Due to the increased significance and new funding incentives placed upon systems involving innovative and alternative technology, energy conservation, resource recovery, new Federal regulations governing the land application of wastewater sludges, increased public concern regarding odors, and desire to provide more in-depth analyses of some of the facilities plan proposals and alternative processes, the City of Albuquerque entered into a program of revising and upgrading its areawide facilities plan. An additional study entitled "City of Albuquerque, New Mexico Southside Wastewater Reclamation Plant No. 2 - Phase II Expansion Report" was published during January 1980. The final version of this report was completed during January 1981 and was received by EPA as an official facilities plan amendment on 27 January 1981.

Prior to the receipt of the City's final facilities plan amendment, EPA determined that the awarding of funds to implement the City's proposed changes was a major action with potentially significant impacts on the human environment, and on 22 August 1980 issued a Notice of Intent to prepare a Supplemental EIS on the project.

1.2 DESCRIPTION OF PROPOSED PROJECT

The City of Albuquerque recognized a need for a modified sludge management program to supplement its wastewater treatment facilities because of the evolution of several situations:

- Increased quantities of sludge will be generated as a result of expansion of the City of Albuquerque wastewater collection system, expansion and modification of treatment Plant No. 2, and population growth in the Albuquerque area. Existing sludge drying beds are adequate to handle approximately 35% of the 10,740 tons per year of dry solids projected for 1990. Compounding the problem, state-owned land currently being used for dedicated land disposal of excess sludge currently produced will be unavailable to the City after 1982.
- The public has expressed strong disapproval of sludge drying beds currently used at Plant No. 2 because of aesthetic and odor considerations.
- New Federal regulations (40 CFR, Part 257.3-6) governing application of sludge on land prohibit the continued practice of spreading sludge on parks or golf courses without prior disinfection.
- Numerous operation and maintenance problems have been encountered since the City's initial facilities plan was completed in 1977.

Because of these situations, the City's facilities plan amendment proposes design and construction of a new sludge management system. The City's proposed sludge facilities include the following components (i.e., treatment units):

- Sludge thickening will be accomplished by expanded dissolved air flotation units at Plant No. 2.
- Stabilization will be accomplished by new, additional anaerobic digesters at Plant No. 2.

- Transportation of sludge to Montesa Park will be accomplished by pumping sludge through an 8" PVC pipeline approximately five miles long. Two lift stations will be required, one at Plant No. 2 and one approximately half way to Montesa Park.

- Conditioning of sludge prior to dewatering will be accomplished by adding organic polymer(s).

- Dewatering from 3% to 25% solids will be accomplished by using belt presses constructed inside an enclosed structure.

- Drying from 25% to 35% solids will be accomplished using large, solar-heated greenhouses. Drying from 35% to 40% solids will be conducted by using approximately 3 acres of open-air drying stockpiles.

- Disinfection of the 40% solid sludge will be accomplished by exposing the sludge to Cesium-137, a nuclear waste product. This process will be conducted within a massive underground reinforced concrete irradiator. Following disinfection, the sludge will be stockpiled for several months at Montesa Park, where it will dry from 40% to approximately 75%-90% solids.

- Disposal of the 90% solid, stockpiled sludge will be accomplished by the City Parks Department hauling sludge (up to 7000 tons per year) to city parks and golf courses for ultimate disposal by landspreading. An additional 3740 tons of sludge per year will be disposed on other public lands, or by selling to consumers either in bulk or in bags.

Federal financing for the proposed sludge management facilities has been requested by the City of Albuquerque under the statutory authority of the Clean Water Act of 1977 (Public Law 95-217). The City's consultants have estimated the total construction cost of the proposed sludge management facilities to be approximately $17 million at December 1980 price levels (CDM 1980b). Revised estimates indicate that the proposed system will cost slightly over $20 million at December 1980 price levels. Under current EPA funding guidelines, the proposed project is eligible for a 75% grant with exception of the Cesium-137 irradiator which potentially can be eligible for an 85% grant. In addition, the proposed project potentially is eligible for a 12.5% grant from the New Mexico Environmental Improvement Division (NMEID). If EPA decides not to fund the proposed project or any alternative, funding of an undetermined amount still could be granted by the NMEID.

1.3 ALTERNATIVES TO THE PROPOSED PROJECT

One alternative to the proposed action is no action. Implementation of no action by the City would result in 60 mgd of wastewater in 1990 flowing into a treatment facility designed to treat 47 mgd, and with a sludge management system that is only able to handle the sludge produced by treating 30 to 33 mgd of wastewater. Sludge produced by treating 30 to 33 mgd of wastewater would be dewatered on existing sand drying beds, and then stockpiled at Montesa Park. Sludge produced by treating the remaining 27 to 30 mgd of wastewater potentially would be stored in sludge lagoons north of treatment Plant No. 2. The no action alternative is not a feasible alternative.

The City of Albuquerque evaluated 7 action alternatives in their facilities plan (6 alternatives plus the proposed project). The City's alternatives primarily included evaluations of various transportation options (pumping sludge through pipelines, or hauling it by truck); various disinfection options (Cesium-137, electron beam, and composting); and various ultimate disposal options (landspreading, landfilling, and dedicated land disposal). EPA evaluated 14 action alternatives plus the no action alternative; however, the main options of transportation, disinfection, and disposal evaluated by EPA were basically identical to those identified by the City. Table 1-1 lists the 14 action alternatives evaluated by EPA. The 14 action alternatives were grouped according to ultimate disposal method as follows: Group 1 alternatives (1A-1H) involve disposal by landspreading on public lands; Group 2 alternatives (2A-2B) involve disposal in a municipal landfill north of the City; and Group 3 alternatives (3A-3D) involve dedicated land disposal on one of two 3580 ac sites to the west of the City.

A cost-effectiveness analysis was conducted which indicated the City's proposed sludge management system may not be the most cost-effective system available. When a comparison was made of the total present worth (or total annual equivalent) cost of the alternatives, then the most cost-effective system appeared to be Alternative 2B, which utilizes the landfill concept.

Table 1-1. Action alternatives evaluated for the Albuquerque sludge management system.

Group 1 - Landspread Concept

NO.	ALTERNATIVE	THICKENING	STABILIZATION	TRANSPORTATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	DISPOSAL
1	1A	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Solar Greenhouse to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
2	1B	Dissolved Air Flotation	Anaerobic Digestion	Pipeline to Montessa Park	Organic Polymer	Belt Press to 25%	Solar Greenhouse to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
3	1C	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
4	1D	Dissolved Air Flotation	Anaerobic Digestion	Pipe to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
5	1E	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 20%	—	Composting	Landspread on City Parks and Golf Courses
6	1F	Dissolved Air Flotation	Anaerobic Digestion	Pipeline to Montessa Park	Organic Polymer	Belt Press to 20%	—	Composting	Landspread on City Parks and Golf Courses
7	1G	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Electron Beam Irradiation	Landspread on City Parks and Golf Courses
8	1H	Dissolved Air Flotation	Anaerobic Digestion	Pipe to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Electron Beam Irradiation	Landspread on City Parks and Golf Courses

Table 1-1. Action alternatives evaluated for the Albuquerque sludge management system(concluded)

Group 2 - Landfill Concept

NO.	ALTERNATIVE	THICKENING	STABILIZATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	TRANSPORTATION	DISPOSAL
9	2A	Dissolved Air Flotation	Anaerobic Digestion	Polymer	Belt Press to 20%	—	—	Truck to Landfill	Landfill
10	2B	Dissolved Air Flotation	Anaerobic Digestion	Lime/Ferric Chloride	Pressure Filters to 35%	—	—	Truck to Landfill	Landfill
	Group 3 - Dedicated Land Disposal Concept								
11	3A	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Truck to Pajarito	Dedicated Land Disposal
12	3B	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Pipeline to Pajarito	Dedicated Land Disposal
13	3C	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Pipeline to Rio Puerco	Dedicated Land Disposal
14	3D	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Truck to Rio Puerco	Dedicated Land Disposal

— Not Applicable

1.4 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

Implementation of the no action alternative will possibly result in the following: toxic materials build-up in soils at Plant No. 2 and at Montesa Park; degradation of surface water quality in the Rio Grande and in Tijeras Arroyo; contamination of groundwater in the south valley near Plant No. 2; extreme odors at Plant No. 2 and Montesa Park, and fugitive dust at Montesa Park; stagnation of growth in the City with a subsequent drop in the economy; potential environmental health problems in the south valley; and aesthetically displeasing conditions both near Plant No. 2 and Montesa Park.

Construction and operation of any of the action alternatives will result in both adverse and beneficial effects in many topic categories (i.e., disciplines). It is noted that alternatives in one group (e.g., Group 1) tend to have similar effects with respect to individual disciplines. The presence of major adverse effects of the 14 action alternatives are listed by discipline in Table 1-2.

Alternatives available to EPA basically include: (1) issuance of a grant for the design and construction of sludge management facilities, and (2) denial of a grant. Other agencies that have grant issuance and/or permit issuance authority also have the alternatives of grant/permit issuance or denial. Denial of a grant and/or permit by EPA or other agencies will most likely result in the City taking no action, and thus the effects potentially will be similar to the effects of the no action alternative described above. Issuance of grants and permits will result in construction of one of the action alternatives, with associated effects present for various disciplines as listed in Table 1-2.

The grant applicant (i.e. City of Albuquerque) and EPA currently are evaluating mitigation measures that are available for implementation in order to reduce or eliminate adverse environmental consequences associated with the alternative sludge management systems.

Table 1-2. Alternatives which cause major adverse effects (by discipline).

Alternative	Earth Resources	Surface Water Resources	Groundwater Resources	Air Resources	Biological Resources	Cultural Resources	Population	Transportation/Land Use	Energy	Environmental Health	Recreation/Aesthetics	Total Number of Disciplines Affected
1A		●	●	●		●	●	●		●		7
1B*	●	●	●	●		●			●	●		7
1C	●	●	●	●		●	●	●		●		8
1D	●	●	●	●		●				●		6
1E		●	●	●		●	●	●		●	●	8
1F	●	●	●	●		●				●	●	7
1G	●	●	●	●		●	●	●	●	●		9
1H	●	●	●	●		●			●	●		7
2A			●			●				●		3
2B			●			●				●		3
3A	●	●		●	●	●	●	●	●	●		9
3B	●	●		●	●	●		●		●		7
3C	●	●		●	●	●		●	●	●		8
3D	●	●		●	●	●		●	●	●		8

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*City of Albuquerque proposed project.

1.5 COORDINATION

EPA Region 6 has made a concerted effort to involve other Federal, state, and local agencies and the general public in the development of this document. A public scoping meeting was held on 7 October 1980 in Albuquerque. Two Federal agencies (USDA/SCS and USDOE) agreed to be cooperating agencies. A public meeting was held on 8 July 1981 to discuss the screening of alternatives and the progress of the EIS. Many Citizens Advisory Committee meetings were held. Additionally, public information depositories were established and are being maintained in 6 convenient public buildings located throughout Albuquerque for the duration of the project. A public hearing to receive comments on the draft Supplemental EIS and facility plan amendment is scheduled to be held in Albuquerque in early November 1981.

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CHAPTER 3.0

INTRODUCTION

3.0 INTRODUCTION

3.1 BACKGROUND ON GRANT APPLICANT AND PREVIOUS GRANT APPLICATION(S)

On 29 June 1974, EPA awarded a Step 1 Grant (C-35-1029-01) pursuant to Section 201 of the Clean Water Act (CWA) to the City of Albuquerque, New Mexico, for preparation of a wastewater collection and treatment facilities plan. Based on the facilities plan submitted by the City, EPA prepared and issued a Draft Environmental Impact Statement (EIS) in June 1977 and a Final EIS in August 1977. On 18 September 1978, EPA approved the City's facilities plan. In June 1980, the City submitted a letter to EPA stating that the City desired to make several changes to the sludge management portion of its facilities plan. Pursuant to the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations, EPA Region 6 determined that the requested amendments (i.e., changes) in the sludge management section of the facilities plan were major and necessitated a supplement to the Final EIS prepared in August 1977. On 22 August 1980, EPA issued a Notice of Intent to prepare a supplemental EIS evaluating various sludge management system alternatives, including the one proposed by the City. The City's proposed sludge management system (Figure 3-1) consists of thickening (dissolved air flotation) and stabilization (two-stage anaerobic digestion) at Treatment Plant No. 2, followed by transfer of the digested sludge through a pipeline to Montesa Park where it will be mechanically dewatered (belt press), disinfected with Cesium-137, dried in a greenhouse using solar energy, and ultimately disposed by landspreading on public lands such as City owned parks and golf courses.

3.2 EPA LEGISLATIVE AUTHORITY AND RESPONSIBILITIES

The National Environmental Policy Act of 1969 requires a Federal agency to prepare an EIS on ". . . major Federal actions significantly affecting the quality of the human environment . . ." In addition, the Council on Environmental Quality published regulations (40 CFR Parts 1500-1508) to guide Federal agencies in the preparation of EIS's and implementation of the Act. EPA also has developed regulations (40 CRF Part 6) for implementation of the EIS process.

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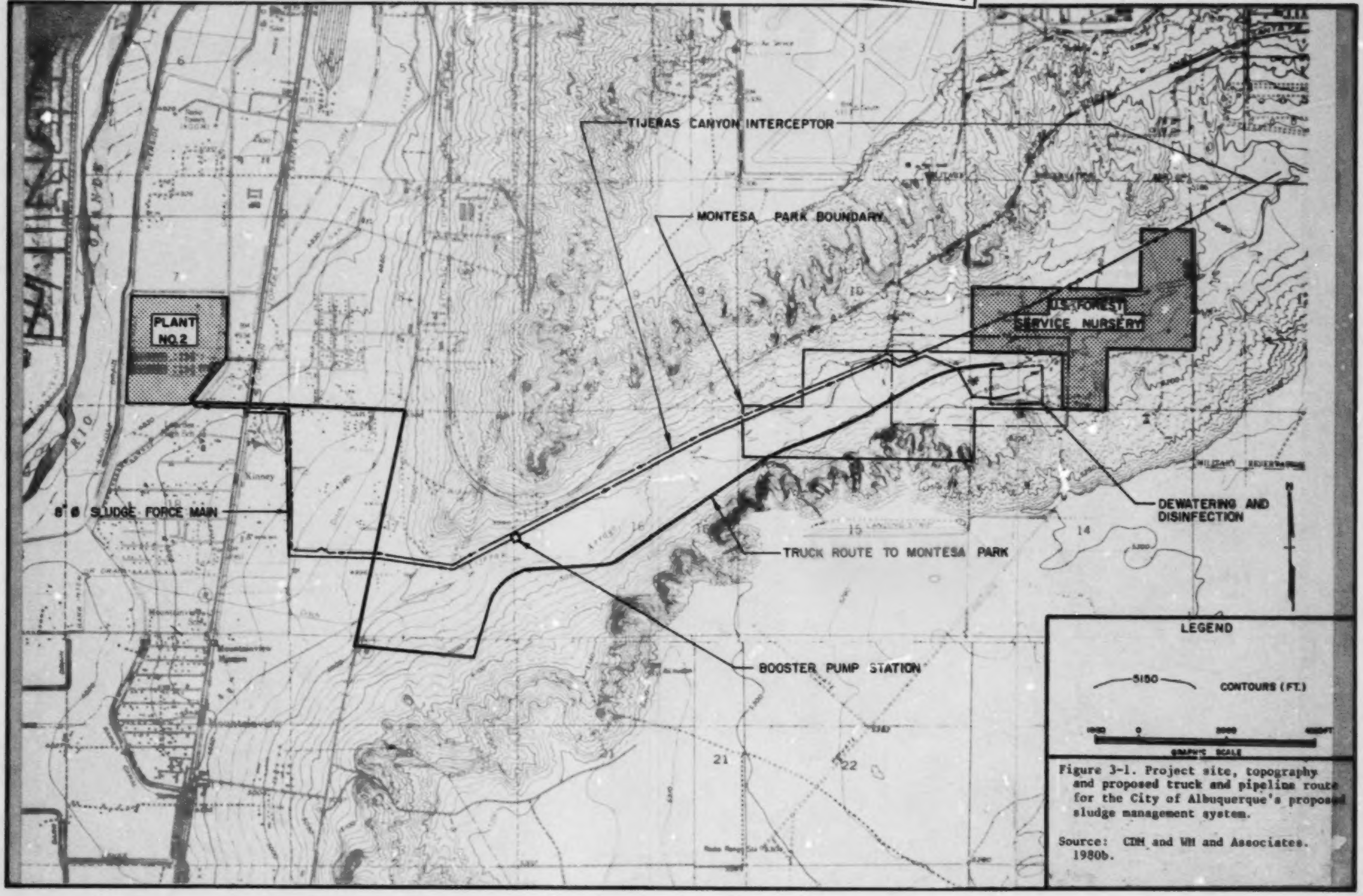
TIJERAS CANYON INTERCEPTOR
MONTESA PARK BOUNDARY
U.S. FOREST SERVICE NURSERY
PLANT NO. 2
RIO GRANDE
8" Ø SLUDGE FORCE MAIN
DEWATERING AND DISINFECTION
TRUCK ROUTE TO MONTESA PARK
BOOSTER PUMP STATION
N
LEGEND
5150
CONTOURS (FT.)
0
GRAPHIC SCALE

Figure 3-1. Project site, topography and proposed truck and pipeline route for the City of Albuquerque's proposed sludge management system.

Source: CDM and WH and Associates. 1980b.

Federal funding for wastewater treatment projects is provided under Section 201 of the Clean Water Act of 1977 (Public Law 95-217). This Act provides 75% Federal funding (i.e., grants) for eligible planning, design, and construction costs; the grant applicant pays the remaining 25% plus all operation and maintenance expenses. Portions of projects that are defined as innovative or alternative are eligible for 85% funding under the Clean Water Act. Funding of an additional 12.5% of eligible costs also is available under the New Mexico Environmental Improvement Division (NMEID) Construction Grants program. A three-step grant process is provided by the Clean Water Act's Construction Grants program. Step 1 involves facilities planning; Step 2 involves development of detailed engineering plans and specifications; and Step 3 involves construction of the pollution control facilities. The City of Albuquerque's sludge management project currently is in Step 1, with the facilities plan amendment developed for design year 1990.

The Clean Water Act requires that EPA identify and select for funding an alternative that is cost-effective, environmentally sound, and publically acceptable. EPA defines a cost-effective alternative as one that has minimum total resource costs over the life of the project and meets Federal, state, and local requirements. It is not necessarily the least-cost alternative. The choice of the most cost-effective alternative is based on both capital (construction) costs and operation and maintenance costs for a twenty-year period, although only capital costs are grant eligible.

3.3 OTHER FEDERAL AND STATE LEGISLATIVE REQUIREMENTS

Sludge management is subject to a number of legislative and institutional requirements; however, sludge usually has not been singled out for separate legislative treatment at the state or Federal level. Instead, it has been included within the statutory scope of regulations concerning substances generally considered to be pollutants that are discharged into water or disposed on land. Under these regulations, disposal of raw or treated sludge into water is subject to restrictions relating to biochemical oxygen demand (BOD), coliform organisms, suspended or settleable solids, and toxic materials. The net effect has been to inhibit disposal of sludge directly into receiving waters. Disposal on land has been legally and successfully practiced provided that the procedures used met requirements applicable in general to solid wastes, and did not conflict with general nuisance laws or restrictions on use of the land in question. Air quality requirements have not been phrased specifically with respect to sludge disposal. Legislators currently are becoming aware of problems associated with sludge treatment and disposal, but these problems are still considered mainly as subordinate elements of solid or liquid waste management. Table 3-1 lists pertinent Federal, state, and local environmental legislation and regulations affecting sludge management alternatives that are applicable to the City of Albuquerque sludge management system.

Table 3-1. Pertinent Federal, state, and local environmental legislation and regulations affecting sludge management alternatives applicable to the City of Albuquerque sludge management system.

FEDERAL LEGISLATION	APPLICABLE FEDERAL REGULATIONS
Federal Water Pollution Control Act Amendments of 1972	National Pollution Discharge Elimination System (NPDES), 40 CFR Part 125
Safe Drinking Water Act	
Clean Air Amendments of 1970	
National Environmental Policy Act of 1969	
Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act	Hazardous Waste Regulations 40 CFR Parts 260-265 Criteria for the Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)
Toxic Substances Control Act	PCB Regulations (40 CFR Part 761)
Clean Water Act	Criteria for the Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257) Federal Construction Grants Regulations (40 CFR Part 35)
Atomic Energy Act of 1954, as amended	Standards for Protection Against Radiation (10 CFR Part 20) Domestic Licensing of Production and Utilization Facilities (10 CFR Part 50) Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions (10 CFR Part 71)

Table 3-1. Pertinent Federal, state, and local environmental legislation and regulations affecting sludge management alternatives applicable to the City of Albuquerque sludge management system (concluded).

STATE LEGISLATION	STATE REGULATIONS
New Mexico Air Control Act	
Public Nuisance Provision, New Mexico Statutes	
New Mexico Water Quality Act as amended	Water Quality Control Commission Regulations for Surface Water and Groundwater

LOCAL MUNICIPAL AND COUNTY REGULATIONS

Air Pollution Control Regulation of the Albuquerque-Bernalillo County Air Control Board

Zoning Ordinances of the Albuquerque/Bernalillo County Planning Department

Section 6-22 of City Code - Noise Control

1973 Lawsuit and Stipulation (Mt. View et al. vs. Fri et al.), control of odor and use of "Best Practical Control Technology".

1980 Lawsuit and Stipulation (State of New Mexico vs. City of Albuquerque), requiring the City to (1) not vent odorous gases, (2) discontinue the use of sludge drying beds at Plant No. 1, (3) remove sludge on a daily basis from Plant No. 1, and (4) renovate the sludge digesters.

CHAPTER 4.0

NEED AND PURPOSE

4.0 NEED AND PURPOSE

4.1 NEED FOR THE PROJECT

The City of Albuquerque needs a modified sludge management system to supplement its wastewater treatment facilities because of the evolution of several situations:

- Increased quantities of sludge will be generated as a result of the expansion of the City of Albuquerque wastewater collection system, the expansion and modification of the treatment facility, and population growth in the Albuquerque area. Existing sludge drying beds are only adequate to handle approximately 35% of the 10,740 tons per year (chart to convert units from English to metric is included in Appendix) of dry solids (i.e., sludge) projected for 1990. Compounding the problem, state-owned land currently being used for dedicated land disposal of part of the sludge will be unavailable to the City after 1982.
- The public has expressed strong disapproval of the sludge drying beds currently utilized at treatment plant No. 2 because of aesthetic and odor considerations.
- New Federal regulations (40 CFR, Part 257.3-6) governing the application of sludge on land prohibit the continued practice of spreading sludge on parks or golf courses without disinfection.
- Numerous operation and maintenance problems have been encountered since the City's initial facilities plan was completed in 1977.
- Dramatic increases in energy costs since the Facilities Plan was prepared warrant greater emphasis on energy conservation and incorporation of efficient internal energy utilization concepts at plant No. 2.

4.2 PURPOSE OF THE EIS

On 22 August 1980, EPA Region 6 issued a Notice of Intent to prepare a supplemental Environmental Impact Statement to fulfill requirements of 40 CFR 1502.9 of the NEPA regulations. Specifically, the portion of the City's facility plan amendment that describes the proposed system for the treatment, transport, and disposal of sludge was determined to be a major change requiring preparation of a supplemental EIS. The major amendments to the City's 1977 facilities plan that involve sludge management are:

- a 5 mile pipeline to pump sludge east from Plant No. 2 to Montesa Park,
- sludge dewatering at Montesa Park using belt presses and solar greenhouses,
- irradiation of dewatered sludge with Cesium-137, a nuclear waste, to reduce pathogens,
- stockpiling of sludge at Montesa Park,
- ultimate use of irradiated sludge as a fertilizer/soil conditioner on public lands such as City parks and golf courses.

The purpose of this supplemental EIS is to evaluate the cost-effectiveness and environmental consequences of the City's recently proposed sludge management plan as well as other sludge treatment alternatives.

4.3 KEY ISSUES

This supplemental EIS concentrates on many issues identified by EPA and the affected public during conduct of the EIS public participation program, including:

- Odors from treatment plants and portions of the sewer network have provoked many public complaints. Hence, effects of odors (if any) associated with sludge management facilities on individuals who work at the facilities and people residing nearby are a major concern.
- The potential for toxic materials, pathogens, and radiation to contaminate soil, water, air, vegetation, and animal life, and ultimately to be hazardous to humans due to land application of sludge is a major concern.
- Since the proposed sludge irradiation process incorporates a radioactive source (Cesium-137), possible effects of radioactive emissions in air, water, and surrounding soil during transportation, installation, utilization, removal, and ultimate disposal of the source also are major concerns.

CHAPTER 5.0

DESCRIPTION AND EVALUATION OF ALTERNATIVES

5.0 DESCRIPTION AND EVALUATION OF ALTERNATIVES

5.1 EXISTING AND PROJECTED SLUDGE QUANTITIES AND CHARACTERISTICS

The volume and composition of sludge largely determine the alternatives available for its disposal and the impacts of sludge on the environment. Sludge characteristics are, naturally, dependent upon inputs and treatment processes. The following sections describe processes currently used by the City of Albuquerque for the treatment and disposal of sludge, and present information concerning the quantities and characteristics of sludge anticipated to be generated during the planning period (1984-1990).

5.1.1 Existing Sludge Quantities and Characteristics

Currently, Albuquerque wastewater is treated in two treatment plants. Plant No. 1, constructed in 1939, and the original Plant No. 2, constructed in two phases in 1960 and 1967, are both trickling filter facilities. Both are currently operating; however, Plant No. 1 is used only for primary treatment of sewage followed by transfer of the effluent to Plant No. 2. An activated sludge plant was constructed on the Plant No. 2 site in 1975 and is used to polish the trickling filter effluents from both Plant No. 1 and No. 2 prior to discharge. In 1980, the activated sludge plant was expanded to process 47 mgd from the original 36 mgd capacity. The construction was carried out under the City's Phase I-A expansion program. The facilities plan amendment is designed under the Phase II expansion program (59 mgd capacity by 1983); a Phase III expansion program will allow the activated sludge plant to treat 76 mgd by about 1990. Upon completion of Phase II improvements, Plant No. 1 will be abandoned in accordance with the City's original facilities plan. Therefore, for the purposes of planning the City's sludge management program for design year 1990, it is assumed that all sludge will be produced at Plant No. 2.

Sludge produced at Plant No. 2 currently is anaerobically digested, air dried on open sand beds, ground using a mobile belt-type shredder, and used as a soil conditioner on parks in the area. Truck hauling of liquid sludge to temporary lagoons off the site also has been utilized in the past as an emergency measure and to permit better odor control (CDM 1980b). Recently, excess sludge produced at Plant No. 2 (i.e., sludge in volumes that exceed the capacity of the sand drying beds at Plant No. 2) has been disposed in the City landfill, or by using dedicated land disposal techniques on University of New Mexico land just south of Montesa Park, or by surface land disposal (i.e., surface spraying) on agricultural lands adjacent to the Plant No. 2 site.

In 1978, an average of approximately 100,000 gallons per day (gpd) of wet sludge were hauled from Plant No. 2. According to operating records, a total of 238 beds of liquid sludge were poured in 1978, and approximately 6,280 cu yd of sludge cake were removed from these beds (CDM 1980b).

Improvements recently constructed at Plant No. 2 included 30 new drying beds. These beds increased the net bed area at the plant by 55%. Pertinent information concerning the drying beds at treatment plant No. 2 is summarized in Table 5.1. The bulk density of sludge cake currently removed from the drying beds is on the order of 1,700 lb/cu yd, and the solid content varies between 35-55%. Table 5.2 lists information concerning the heavy metals content of sludge produced at Plant No. 2 (CDM 1980b). Table 5.3 denotes solubility, soil mobility, and toxicity characteristics of these heavy metals.

5.1.2 Projected Sludge Quantities and Characteristics

Estimates of the raw solids production anticipated to occur in design year 1990 (i.e., Phase II) are described in the City's facilities plan amendment. Total raw sludge production is expected to be approximately 108,500 dry lb/day (54 tons/day) at an average solids concentration of 4.8% (Table 5.4). Approximately 58,855 lb/day (about 30 tons/day) of digested sludge will need to be handled by the City's sludge management system.

5.2 NO ACTION ALTERNATIVE

One alternative always available to the grant applicant (i.e., the City) is the "no action" alternative. For the purposes of this EIS, "no le 5-1. Characteristics of drying bed facilities at the City's wastewater treatment Plant No. 2.

Characteristic	System North Beds	 South Beds	 Phase 1-A	Total
Year Built	1962	1967	1980[1]	
Number of Beds	40	42	30	112
Bed Size (ft)	40x100	40x100	40x150	
Piped Underdrain System	Yes	Yes	Yes	
Filtrate Disposition	To plant effluent upstream of chlorination	To aeration tank influent	To aeration tank influent	
Bed Lining	None	None	Plastic membrane	
Area - Sq ft per bed	4,000	4,000	6,000	
- Total sq ft	160,000	168,000	180,000	508,000
Capacity[2] (in tons dry solids per yr)	1,200	1,260	1,350	3,810

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[1] Completed in 1981.

[2] At 15 lb dry solids per sq ft per yr.

Source: Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980b. City of Albuquerque, New Mexico southside wastewater treatmen plant phase II expansion program engineering report. Albuquerque NM, variously paged.

Table 5-2. Heavy metals concentrations contained in samples of digested sludge produced at Plant No. 2 (in mg/kg of dried materials).

Metals		One Sample Per Month[2] Feb-Sep 1976			Oct-Nov 1979 Samples[3]		
		Low	High	Average	Low	High	Average
Al	Aluminum	1120	17000	11000	498	17425	10960
Sb	Antimony[1]	40	50	-	ND(1)	9	-
As	Arsenic	10	200	40	10	20	14
Ba	Barium	50	1000	450	356	628	482
Be	Beryllium	2	10	22	0.63	14	3.5
Bo	Boron	20	70	40	7	71.4	25
Cd	Cadmium	15	40	22	12	25.6	19
Cr	Chromium	260	440	340	227	440	281
Co	Cobalt	10	10	10	10	28	19
Cu	Copper	780	2000	1690	693	1185	1013
Fe	Iron	13000	18300	15000	8660	18440	13410
Pb	Lead	630	1000	750	476	1278	901
Mn	Manganese	190	270	220	162	314	225
Hg	Mercury	6	40	19	2	5	3.2
Mo	Molybdenum	5	10	10	4.5	107	35
Ni	Nickel	110	200	170	87	140	128
Ag	Silver[4]	260	210	160	38	314	178
Se	Selenium	5	10	10	1	3	2.4
Te	Tellurium	10	50	30	-	-	-
Tl	Thallium[4]	10	30	-	0.5	45	18
V	Vanadium	50	100	80	39	65	53
Zn	Zinc	220	2100	1390	1370	3900	1860

---

[1] ND = none detected. Number in parentheses indicates detection limits of method employed.

[2] From Environmental Impact Statement, Table A4 (USEPA 1977b).

[3] Five samples. Averages are not statistically significant because of small number of samples and the fact that many values are less than detection limits. Blanks (-) indicate no data.

[4] Three samples in 1979.

Source: Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980b. City of Albuquerque, New Mexico southside wastewater treatment plant phase II expansion program engineering report. Albuquerque NM, variously paged.

Table 5-3. Typical solubility, soil mobility, and toxicity characteristics of heavy metals similar to those found in sludge at Plant No. 2.

	Common Water Soluble Forms					
Metals	**Sulfides**	**Oxides**	**Borates Nitrates Carbonates**	**Sulfates**	**Vanadates Arsenates Phosphates**	**Comments**
Al	x		x			
Sb			x		x	Insoluble in normal soils
As			x		x	
Ba	x	x			x	No problem if clay present in soils
Be	x		x	x	x	Not toxic
B	x		x	x	x	Directly affects humans
Cd				x	x	
Cr	x		x	x	x	Immobile in soil
Co						
Cu						Soluble in low pH only, affects livestock
Fe						Soluble in very low pH only
Pb						
Mn	x					
Hg			x		x	No problem if clay present in soils
Mo			x	x	x	Affects livestock
Ni						Not toxic in levels in sludge
Ag			x	x	x	Directly affects humans and livestock
Se			x	x	x	
Te		x	x	x	x	
Tl			x	x	x	
V	x		x			
Zn						Not toxic

Table 5-4. Quantities and characteristics of solids (sludge) anticipated to be produced at Plant No. 2 in design year 1990.

Screenings	8168 lb/day dry solids
Grit	7787 lb/day dry solids

Sludges	Dry Solids lb/day	Dry Solids %	% Solids	Volume gpd	% Volatiles
Raw					
Primary	68,675	63	5.0	161,000	70
Total waste activated sludge	39,772	37	4.5	106,000	82
Total/Average	108,447	100	4.8	267,000	74
Digested	58,855		3.0	235,000	58

Parameter[1,2]	%, Dry Solids Basis
Total Kjeldahl Nitrogen	2.3
Ammonia Nitrogen	0.1
Nitrate Nitrogen	Negligible
Nitrite Nitrogen	Negligible
Phosphorus as P_2O_5	1.9
Potassium as K_2CO_3	0.2
pH Range	6.0 to 6.5
Polychlorinated Biphenyls	Below detection limit of 5 mg/kg dry, 100 mg/l wet

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[1,2] Summary of data extracted from NMSU studies in 1976 and 1977, and from testing conducted Oct-Nov 1979 for the City's facilities plan amendment.

Source: Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980b. City of Albuquerque, New Mexico southwide wastewater treatment plant phase II expansion program engineering report. Albuquerque NM, variously paged.

action" consists of the situation that potentially would occur if the City chose to deny a grant offer and to not construct either their preferred sludge management system or any alternative system.

The expansion of the wastewater collection and treatment system to 47 mgd capacity initiated under Phase I-A, is nearing completion. At present, sludge dried on sludge drying beds at Plant No. 2 is stockpiled at Montesa Park. In addition, sludge that exceeds the capacity of the drying beds is disposed of in liquid form (3% solids), using dedicated land disposal techniques on land leased from the state (the non-renewable lease for the state land terminates in mid-1982), land filling, and surface spreading techniques. The proposed Phase II expansion of the City's wastewater treatment facilities consists of the following:

- increase plant capacity from 47 to 60 mgd,
- abandon Plant No. 1,
- landfill grit, and
- construct sludge dewatering and disinfection units at Montesa Park and dispose sludge by landspreading on City lands.

EPA anticipates continued funding of the proposed collection system to a 60 mgd capacity. However, if the City chose not to construct adequate sludge management facilities, it is unlikely that EPA would fund further expansion of the liquid waste treatment units at Plant No. 2 beyond the current 47 mgd capacity. Therefore, if the City decided to implement the no action alternative and not construct new sludge management facilities, the following situation would exist:

- collection and conveyance of up to 60 mgd raw wastewater to Plant No. 2;
- overloading of the 47 mgd treatment facility (Plant No. 2) by up to 13 mgd, with a resulting decrease in effluent quality;
- major overloading of the sludge drying beds at Plant No. 2.

Under the above conditions, it is anticipated that BOD would be approximately 79 mg/l (39,525 lb/day) and TSS would be approximately 41 mg/l (20,400 lb/day) in the treatment plant effluent, and approximately 58,848 lb/day of dry solids would be produced. The effluent would violate limitations established in the City's state and federal discharge permits.

The City of Albuquerque would have to implement emergency measures in order to handle 60 mgd of wastewater and the subsequent volume of sludge produced. It is anticipated that existing drying beds would continue in operation at maximum capacity. Sludge not dried on drying beds would be stored in lagoons located north of the existing wastewater treatment facilities. Sludge cake removed from the drying beds (47% solids) would be stockpiled at Montesa Park, as at present. It is expected that EPA would exercise its authority to levy fines against the City of Albuquerque for violation of discharge permit effluent limitations.

As a result of no action, there potentially would be environmental degradation to the Rio Grande River from deteriorated effluent quality; to groundwater from leachate emanated from the sludge lagoons, unlined drying beds, and stockpiles; and to receiving surface waters from lagoon overflow and stockpile runoff. Water soluble components of heavy metals currently found in the sludge that might contaminate the groundwater or surface water via sludge leachate, are listed in Table 5.3.

The scenario outlined above could only exist on a short-term basis. Although it is unlikely, the City of Albuquerque could choose to pay fines levied against it for noncompliance with permit stipulations. However, because lagoons and stockpiles require large land areas that are aesthetically displeasing, are unacceptable as long-term sludge disposal methods, and would be in violation of recent legal stipulations, the City of Albuquerque eventually would have to take long-term action to address the needs of their sludge management system.

5.3 SCREENING OF PRELIMINARY SLUDGE TREATMENT AND DISPOSAL COMPONENTS AND COMPONENT OPTIONS

The screening (i.e., evaluation) of preliminary sludge management alternatives was accomplished based on the following steps:

- selection of relevant evaluation criteria,

- identifying preliminary alternative components and options,
- screening the list of components and options based upon the evaluation criteria, and
- selecting optimal alternatives for further environmental evaluation.

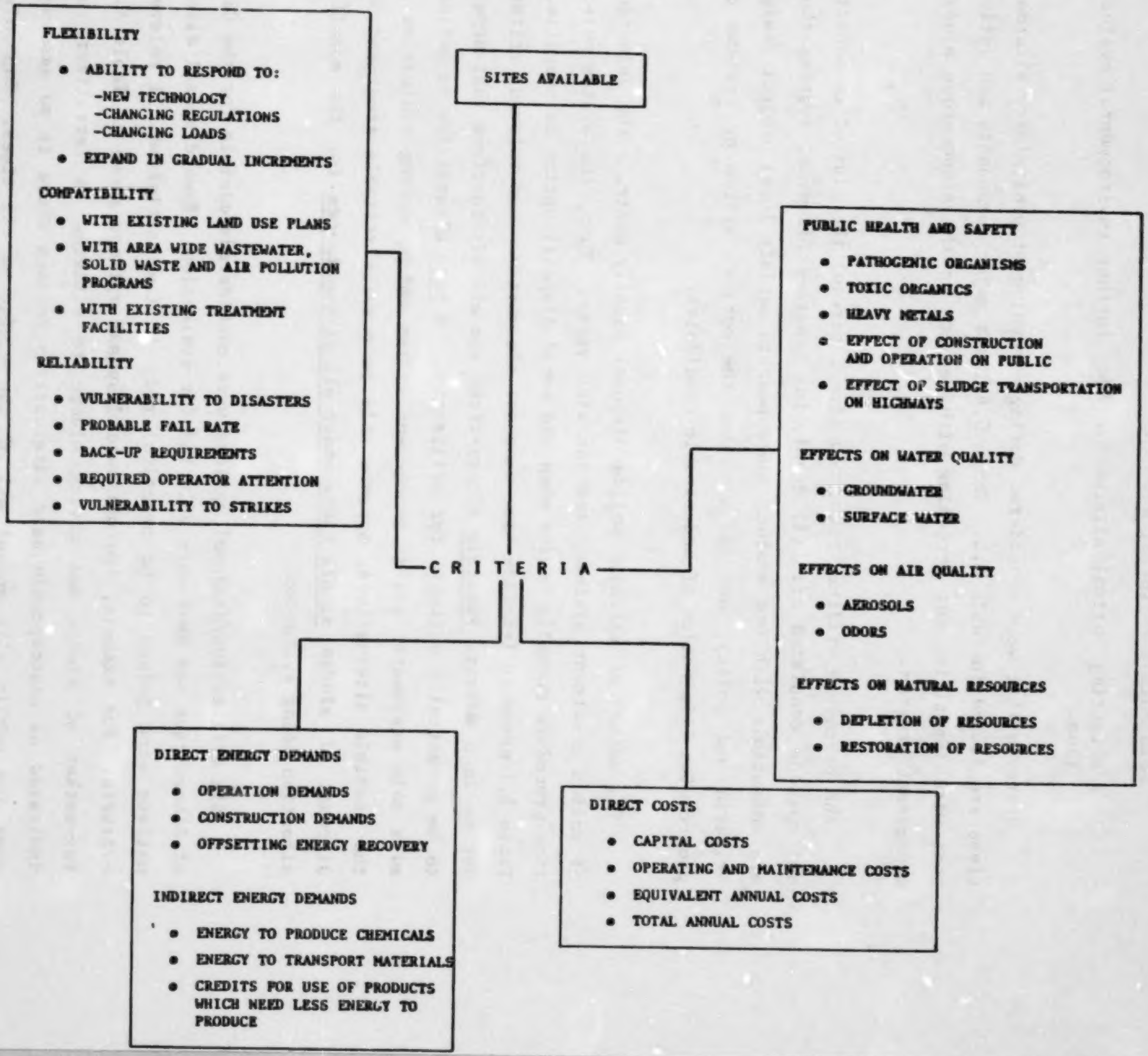
Criteria that were considered during screening of preliminary alternatives are listed in Table 5.5. Table 5.6 lists major components and options that were identified for screening with respect to the Albuquerque sludge management program.

The procedure utilized to narrow (i.e., screen) the list of components and options consisted of: (1) developing treatment/disposal systems that are compatible with one another and appear to satisfy local project design criteria and policy, and (2) choosing the optimal system or systems by progressive elimination of undesirable candidates.

The method of ultimate solids disposal usually controls the selection of solids treatment systems, and not vice versa. Thus, the system selection procedure normally begins when the solid disposal option is specified. Table 5.7 presents feasible base disposal alternatives and relevant criteria set up in a matrix. Feasible alternatives are all alternatives that appear to be potentially suitable for utilization. A base alternative is defined as a sole wastewater solids management system which, during evaluation of the feasible alternatives, appears able to provide reliable treatment and disposal of sludge at all times under all circumstances for the specific situation being evaluated.

Six utilization/disposal options were considered feasible for the City of Albuquerque and thus were selected for evaluation. Base disposal alternatives were judged to be practical only if they satisfied all relevant criteria. For example, two ultimate disposal options shown in Table 5.7, bag-market of sludge and giving sludge to citizens as fertilizer, are indicated as unacceptable base alternatives because there is no assurance that the public will accept all of the sludge at all times. Lagooning, besides being unreliable, is associated with odor and health problems and

Table 5-5. Evaluation criteria utilized for screening preliminary alternative components and component options applicable to the Albuquerque sludge management program.



CRITERIA

SITES AVAILABLE

FLEXIBILITY

- ABILITY TO RESPOND TO:
  - -NEW TECHNOLOGY
  - -CHANGING REGULATIONS
  - -CHANGING LOADS
- EXPAND IN GRADUAL INCREMENTS

COMPATIBILITY

- WITH EXISTING LAND USE PLANS
- WITH AREA WIDE WASTEWATER, SOLID WASTE AND AIR POLLUTION PROGRAMS
- WITH EXISTING TREATMENT FACILITIES

RELIABILITY

- VULNERABILITY TO DISASTERS
- PROBABLE FAIL RATE
- BACK-UP REQUIREMENTS
- REQUIRED OPERATOR ATTENTION
- VULNERABILITY TO STRIKES

PUBLIC HEALTH AND SAFETY

- PATHOGENIC ORGANISMS
- TOXIC ORGANICS
- HEAVY METALS
- EFFECT OF CONSTRUCTION AND OPERATION ON PUBLIC
- EFFECT OF SLUDGE TRANSPORTATION ON HIGHWAYS

EFFECTS ON WATER QUALITY

- GROUNDWATER
- SURFACE WATER

EFFECTS ON AIR QUALITY

- AEROSOLS
- ODORS

EFFECTS ON NATURAL RESOURCES

- DEPLETION OF RESOURCES
- RESTORATION OF RESOURCES

DIRECT ENERGY DEMANDS

- OPERATION DEMANDS
- CONSTRUCTION DEMANDS
- OFFSETTING ENERGY RECOVERY

INDIRECT ENERGY DEMANDS

- ENERGY TO PRODUCE CHEMICALS
- ENERGY TO TRANSPORT MATERIALS
- CREDITS FOR USE OF PRODUCTS WHICH NEED LESS ENERGY TO PRODUCE

DIRECT COSTS

- CAPITAL COSTS
- OPERATING AND MAINTENANCE COSTS
- EQUIVALENT ANNUAL COSTS
- TOTAL ANNUAL COSTS

Table 5-6. Major components and options evaluated for applicability to the Albuquerque sludge management system.

COMPONENTS	OPTIONS
SLUDGE THICKENING	Gravity
	Dissolved Air Flotation
	Centrifuge
STABILIZATION	Anaerobic Digestion
	Aerobic Digestion
	Lime Treatment
CONDITIONING	Lime
	Ferric Chloride
	Organic Polymers
	Elutriation
	Thermal
DEWATERING	Drying Beds
	Lagoons
	Centrifuge
	Vacuum Filters
	Belt Press
	Filter Press
DRYING	Flash Dryer
	Multiple Hearth
	Rotary Kiln
	Atomized Spray Tower
	Solar-Assisted Beds/Kilns
DISINFECTION	Pasteurization
	Composting
	Electron Beam Irradiation
	Cesium-137 Irradiation
	Cobalt-60 Irradiation
REDUCTION	Incineration
	Wet Oxidation
FINAL SLUDGE OR ASH DISPOSAL	Landspreading
	Lagooning
	Dedicated Land Disposal
	Landfilling

Table 5-7. Initial screening matrix for base sludge disposal options.

Feasible Utilization/ Disposal Options	Relevant Criteria: Reliability	Environmental Impacts	Site Availability	Cost	Acceptable for Base Alternative
Bag-market as Fertilizer	x	-	-	-	x
Landspreading on Public Land(s)	-	-	-	-	-
Give to Citizens (horticulture)	x	-	-	-	x
Dedicated Land Disposal	-	-	-	-	-
Landfilling	-	-	-	-	-
Lagooning	x	x	-	x	x

x = Unacceptable

- = Acceptable

thus was not accepted as a base alternative. Alternatives that seemed to satisfy relevant criteria for base disposal alternatives were: (1) landspreading on public lands, (2) landfilling, and (3) dedicated land disposal (Table 5.7).

Once ultimate disposal methods were selected, treatment components required to properly process sludge for each disposal method were identified (Table 5.8). Sludge must be subjected to seven treatment components (i.e., seven treatment processes) before landspreading can be utilized. Similarly, five treatment components are required prior to landfilling, and three treatment components are required prior to disposal by dedicated land disposal.

To further reduce the list of candidate systems, an analysis was performed on components and options by evaluating them with the selected screening criteria. Table 5.9 identifies the results of the preliminary screening evaluation and identifies options that were eliminated from further consideration. Options that were not eliminated during the preliminary screening were combined to form optimal alternatives for the Albuquerque sludge management program. Table 5.10 lists the optimal alternatives that were selected for detailed evaluation during the EIS process.

5.4 DESCRIPTION OF ADDITIONAL OPTIONS DEVELOPED AND EXAMINED DURING PUBLIC REVIEW

Additional options for sludge utilization and/or disposal were evaluated as a result of the City's public participation program. They are:

- land reclamation,
- mining site reclamation,
- mine shaft disposal,
- incineration, including pellets and fuel, and
- wet air oxidation.

Table 5-8. Treatment components (treatment steps) that must be used prior to ultimate disposal of sludge.

COMPONENT ALTERNATIVE	THICKENING	STABILIZATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	REDUCTION	TRANSPORTATION	ULTIMATE DISPOSAL
1	X	X	X	X	X	X		X	LANDSPREAD (City Parks)
2	X	X	X	X				X	LANDFILL
3	X	X						X	DEDICATED LAND DISPOSAL

X - indicates a required component

Table 5.9 Screening of preliminary sludge treatment options applicable to the Albuquerque sludge management program.

						Cost-Effectiveness ($ x 10^6)[1]				Potential Environmental Effects							
Component	Options	Flexibility/ Compatibility	Reliability	Space Requirement	Energy Effectiveness	Capital	Equiv. Annual	O&M	Total Annual	Air	Odor	Health Hazard	Surface Water	Ground-water	Solid Waste	Resource Recovery	Eliminated
Sludge Thickening	Gravity	X				0.53	0.05	0.02	0.07		X						X
	Dissolved Air Flotation				X	0.40	0.04	0.07	0.11	X		X					
	Centrifuge	X	X		X	N/A	N/A	N/A	N/A		X	X					X
Stabilization	Anaerobic Digestion	X				3.20	0.30	0.13	0.43								
	Aerobic Digestion	X			X	3.20	0.30	0.48	0.7		X						X
	Lime Treatment					2.97	0.28	0.52	0.80		X				X	X	X
Conditioning	Lime/Ferric Chloride					0.72	0.07	1.60	1.67						X		
	Organic Polymers					0.26	0.02	0.64	0.66			X					
	Elutriation					N/A	N/A	N/A	N/A			(not allowed by EPA)					X
	Thermal		X		X	4.80	0.46	0.61	1.07		X						X

Table 5.8 Screening of preliminary sludge treatment options applicable to the Albuquerque sludge management program (continued).

Component	Options	Flexibility/ Compatibility	Reliability	Space Requirement	Energy Effectiveness	Cost-Effectiveness ($ x 10^6)^{a,b} Capital	Equiv. Annual	O&M	Total Annual	Potential Environmental Effects Air	Odor	Health Hazard	Surface Water	Ground-water	Solid Waste	Resource Recovery	Eliminated
Dewatering	Drying Beds	X		X		4.00	0.30	0.80	1.10		X						X
	Lagoons																
	Centrifuge		X		X	0.44	0.06	0.56	0.62			X	X				X
	Vacuum Filters	X	X		X	0.45	0.04	1.12	1.16								X
	Belt Press	X			X	1.70	0.17	0.38	0.55								
	Filter Press				X	2.40	0.23	0.64	0.87							X	
Drying	Flash Dryer/ Multiple Hearth/Rotary Kiln/Atomized Spray Tower		X		X	N/A	N/A	N/A	N/A	X		X					X
	Solar Drying			X		7.50	0.72	0.40	1.12								
Disinfection	Pasteurization				X	6.64	0.44	0.58	1.02		X						X
	Composting		X	X		1.36	0.13	0.48	0.61		X	X					
	Electron Beam Irradiation		X			2.31	0.22	0.19	0.41								
	Gamma Irradiation		X			1.72	0.16	0.07	0.23								

Table 5.9 Screening of preliminary sludge treatment options applicable to the Albuquerque sludge management program (concluded).

Component	Options	Flexibility/ Compatibility	Reliability	Space Requirement	Energy Effectiveness	Cost-Effectiveness ($ x 10^6)[1] Capital	Equiv. Annual	O&M	Total Annual	Potential Environmental Effects Air	Odor	Health Hazard	Surface Water	Ground-water	Solid Waste	Resource Recovery	Eliminated
Reduction	Incineration				X							(not allowed by local regulations)					X
	Wet Oxidation	X	X		X							(not allowed by local regulations)					X
Disposal to Land	Landspreading (City Parks)		X			0.64	0.06	0.16	0.22	X	X	X		X			
	Dedicated Land Disposal					0.64	0.06	0.16	0.22		X	X		X		X	
	Lagooning			X		2.72	0.26	0.32	0.58		X	X		X		X	X
	Landfill					0.24	0.02	0.16	0.18		X		X	X		X	
Transportation	Pipeline	X				4.80	0.46	0.08	0.54					X			
	Truck				X	1.77	0.17	1.06	1.23	X							

X - Indicates adverse characteristic

[1] Costs indicated are preliminary costs developed early in the EIS process, and are superceded by costs information presented in Section 5.7 of this document.

Table 5-10. Identification of optimal alternatives selected for detailed evaluation during conduct of the EIS process.

ALTERNATIVE GROUP	THICKENING	STABILIZATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	DISPOSAL	TRANSPORTATION
1	Dissolved Air Flotation	Anaerobic Digestion	Organic Polymer	Belt Press	Solar Open Air	Composting Electron Beam Cesium-137	Landspread on City Parks	Truck or Pipeline to MP
2	Dissolved Air Flotation	Anaerobic Digestion	Polymer Lime/Ferric Chloride	Belt Press Filter Press	-	-	Landfill	Truck to Landfill
3	Dissolved Air Flotation	Anaerobic Digestion	-	-	-	-	Dedicated Land Disposal (Liquid Injection)	Truck to DLD Site Pipeline to DLD Site
4	No Action							

MP - Montesa Park
DLD - Dedicated Land Disposal

Various options of sludge application for the rehabilitation of strip-mined or other low-quality land were examined. In the case of the City of Albuquerque, the nearest suitable open-pit mine (Anaconda's Jackpile Mine, near Paguate NM) is more than 50 mi from the plant, which is more than twice the distance to the landfill. Therefore, based on transportation costs alone, landfilling would be more cost effective than disposing sludge in an open-pit mines. Furthermore, land reclamation activities at the Jackpile Mine are expected to be completed in 1984; thus, the mine will cease to be a potential disposal site even before most of the Phase II solids volumes are generated (i.e., prior to 1984-1990). Disposal in abandoned shaft-type mines was also considered. The nearest such mines are east of the Sandia mountains, in the Golden area. This approach involves many practical problems in preventing groundwater contamination; it also involves high costs of restoring shaft structural integrity, in-mine hauling equipment, and ventilation systems. In addition, these mines are approximately 40 miles from the plant, imposing prohibitive transportation costs. A cement plant located in Tijeras (about 25 mi from Plant No. 2) is also a potential disposal site with prohibitive transportation costs. Long-recognized concerns about the high level of nitrates in groundwater in the vicinity of the Tijeras Arroyo also render large-scale sludge deposition at Tijeras questionable. The apparent absence of a specific long-term land reclamation plan at a Tijeras site militates against its further study at this time.

Sludge pelletization is a disinfection process which, like composting, converts sludge into a useable product. Liquid sludge is first dewatered to 20 percent solids, and then is heat-dried to a 95 percent solids pellet form. The resulting pellets are screened to remove nonbiodegradable materials, and bagged for marketing or for public use. The final product has a bulk density of 45-55 pounds per cubic foot, resulting in a five-fold decrease in volume.

In the sludge pelletization process, mechanically dewatered sludge and some recycled sludge products are initially blended in a screw-mixing bin to provide a low moisture feed for the dryer. Hot gases (1200-1400°F) are then blown into a rotary dryer in a cocurrent flow pattern with the blended sludge feed. After the mixture has undergone a satisfactory detention period (usually 20-60 minutes), the dried sludge (95% solids) is discharged.

The rotary drum usually consists of a cylinderical steel shell revolving at 5-8 rpm. The rotary motion of the drum serves to increase the efficiency of the drying process and assists in forming the pellets. Some dryers use a drum with two internal shells which allow the product to undergo several stages of drying as material proceeds through the internal drums.

Dried pellets are screened to remove non-biodegradables and conveyed by rotary screws to storage bins for truck loading and/or subsequent bagging operations. Discharge air and exhaust gases are passed over a heat exchanger to recover energy, and then directed through an air pollution control system prior to exhaust discharge.

Several system characteristics influence the potential use of a sludge pelletizing operation at Albuquerque. Of these, the most notable is the energy requirement of the pelletizing process. Heat for drying is provided by a furnace buring natural gas. Generally, 2400 BTUs are required to evaporate one pound of water. Alternately, four pounds of water must be evaported to produce one pound of sludge pellets. Based upon 65 percent efficiency, 27,800 cubic feet of natural gas would be required to produce one ton of dried sludge pellets. Utilizing current natural gas prices, energy expenditures would be approximately $100 for each ton of sludge pellets produced. Total operation and maintenance costs (without capital depreciation) would be approximately $140 per ton of pellets produced.

The five-fold reduction in volume during the rotary drying process results in large amounts of water vapor, gases, and particulates being released from the dryer. Without proper air quality control systems, critical air pollution problems could result. Normally, off gases from the rotary dryer pass through a cyclone separator which removes particulates. Further removal of pollutants is generally accomplished through chemical scrubbing and catalytic incineration. Due to the intricacy of the equipment, operation and maintenance of these devices is a critical aspect in the production of acceptable exhaust air. The potency and odorous quality of the off gases makes equipment breakdown extremely costly in terms of enforcement fines and public reaction.

The normal process train requires the operation of approximately 60 types of equipment to produce a sludge pellet. Some of these units, most notably the screw and belt conveyors, are highly vulnerable areas and very sensitive to break downs. Moreover, the abrasive character of sludge pellets produce wearing of the pug mill and screw conveyor blades. Potential for equipment breakdowns due to pellets lodging in motor drives, etc., is very real. The significance of the 60 types of equipment is that approximately 10 items have a long history of breakdowns and could drastically impede the effectiveness of the solids recovery operation.

The principal advantage of this process is that the recoverable product is free of pathogens. The 1200°F drying temperature, coupled with the removal of much of the water, insures almost total pathogen kill. Additionally, this process has certain advantages over composting in that material handling volumes are approximately one-fifth of composting.

Based upon an evaluation of the above information, pelletization was eliminated from consideration as an optimal component option, primarily due to the Air Pollution Control Regulations of Albuquerque which restrict incineration. In addition, since off-gases generated by pelletization are inherently odorous and moderately hot (therefore hard to scrub), and since the resulting product is extremely abrasive, leading to very short-lived sludge handling equipment in full-scale installations, it was concluded that pelletization potentially would not publically acceptable or cost-effective.

Wet air oxidation, such as the Zimmerman or Zimpro process, consist of the reduction (burning) of the wet organic matter in sludge under high temperature and pressure. The process is controlled by four parameters: temperature, air supply, pressure and feed solids concentration. The degree of oxidation (burning) achieved is directly dependent upon the degree of heat and pressure applied.

In the wet air oxidation process, the thickened sludge (at about 6% solids) passes through a grinder to reduce the size of feed solids to less than 1/4 inch, and then the slurry is pressurized. The air quantity supplied is the stoichiometric amount required for complete oxidation of the combustible sludge solids. The sludge-air mixture is then passed through a heat exchanger, where it is heated to close to the desired reaction temperature by the reactor effluent stream and introduced into the reactor for oxidation. Temperature and pressures up to 500°F and 1,000 to 1,800 psig are used, with a detention time of 40 to 60 minutes. The oxidated slurry is then cooled in a heat exchanger, gases are removed in a vapor-liquid separator, and the gases are reduced to atmospheric pressure through a pressure control valve. The gases are processed to eliminate odors. They consist mainly of oxygen, nitrogen, carbon dioxide, and water vapor. Nitrogen oxides are formed from the organic nitrogen present in the feed, but no nitrogen is fixed from the air. Elemental sulfur, hydrogen sulfide, and organic sulfur compounds are oxidized to sulfate (SO_4). Gas clean-up methods have included wet scrubbing, activated carbon absorption, afterburning with fossil fuel, and catalytic oxidation. With the last two methods, energy recovery is possible through use of heat recovery boilers, gas-liquid heat exchangers, and similar methods.

Slurry from the gas-liquid separator is removed through a liquid-level control valve and dewatered for final disposal. At high degrees of oxidation, the residual solids resemble ash from thermal incineration and are easily dewatered to a high solids content by conventional means (settling, centrifugation, or vacuum filtration). The liquid phase is recycled to the treatment plant or given separate treatment for reduction of residual soluble organics.

High pressure/high temperature wet air oxidation processes generate excess heat when they operate with a high heating value sludge and an adequate solids content (approximately six percent). Still, a source of high pressure steam (separate boiler or an existing plant system) must be provided for start-up.

Wet air oxidation systems are capital-intensive and have, in the past, experienced problems with corrosion and safety. These systems seem to be most applicable for industrial waste treatment (Vesilind P. Aarne, 1980). Utiliziation of wet air oxidation for municipal sludge management systems is also possible; however, wet air oxidation was eliminated from consideration as an optimal component option for the Albuquerque EIS process due to the high capital cost and high energy consumption of the process, and due to the fact that the City's air pollution control regulations prohibit incineration in all forms.

5.5 DESCRIPTION OF OPTIMAL ALTERNATIVE COMPONENTS AND COMPONENT OPTIONS

The City of Albuquerque has a number of optimal alternatives available for the treatment and disposal of sludge produced by the proposed 60 mgd wastewater treatment facility. These alternatives can be grouped into three major categories according to ultimate disposal methods. Group 1 alternatives include sludge disposal by landspreading on public lands such as city parks and golf courses; Group 2 alternatives include disposal by landfilling at a new municipal landfill; and Group 3 alternatives include dedicated land disposal. All three groups are made up of combinations of the same eight components: thickening, stabilization, conditioning, transportation, dewatering, drying, disinfection, and disposal. Not all alternatives require all eight components (as indicated in Table 5.8). The following paragraphs provide a discussion of optimal component options adapted to specific site conditions and policies applicable to the Albuquerque sludge management system. Much of the information presented below, which describes how various component options (i.e., treatment process) specifically would be utilized by the City of Albuquerque, is adapted from the City's facility plan amendment and/or from additional reports and process descriptions provided by the City of Albuquerque.

5.5.1 Thickening and Stabilization

During preliminary screening, EPA determined that dissolved air flotation (DAF) of waste-activated sludge is the only thickening option worthy of detailed evaluation, primarily because a dissolved air flotation unit is currently in operation at the treatment plant. It was determined that use of other thickening options such as gravity thickeners or centrifuge units would require duplicate spare parts inventories and new operator training that would not be economically feasible. The existing DAF thickener will be enlarged under Phase II operations.

Five primary anaerobic digesters currently are used to stabilize sludge at the plant. Each is 75 ft in diameter with a side water depth of 22.5 ft. Paired with the primary digesters are five secondary anaerobic digesters of the same dimensions. The primary digesters are mixed and heated, whereas the secondary units are not. Because these digesters currently are in operation at the plant, only anaerobic digestion was considered as an optimal stabilization option after preliminary screening. This is because, similar to the thickening process, it was determined that aerobic digestion units adjacent to anaerobic units would require duplicative spare parts inventories and operator training, and would produce stabilized sludges with non-uniform characteristics. When treatment Plant No. 2 operates at the 60 mgd design rate, it is estimated that 235,000 gpd of liquid sludge (3% solids) will be produced. The average solids concentration of the sludge entering the digesters is anticipated to be 4.8%. The anaerobic digestion system will produce enough methane to generate more electricity than the digestion system itself requries, but will not produce enough electricity to supply the entire wastewater treatment facility (CDM 1980b).

5.5.2 Conditioning

The existing sludge management system does not include sludge conditioning. Conditioning typically involves addition of chemicals to alter the physical and chemical characteristics of sludge, primarily so that subsequent treatment processes (usually dewatering facilities) will operate more efficiently. Two sludge conditioning options considered for detailed evaluation are organic polymer addition and lime/ferric chloride addition. Organic polymers often are used with belt press dewatering units, whereas lime often is added to condition sludge prior to dewatering using filter press units. However, sludge cannot be disposed by landspreading when lime is used as a conditioner because the sludge will be so alkaline that vegetation may not grow following application of the sludge. Conditioning will take place at Montesa Park for landspreading alternatives, and at the treatment plant for landfilling alternatives.

5.5.3 Transportation

Currently, sludge is hauled by 6 cu yd dump trucks from the sludge drying beds at Plant No. 2 to Montesa Park, and by tank truck from Plant No. 2 to a dedicated land disposal site on state land just south of Montesa Park. For proposed optimal alternatives in Group 1, sludge will be transported to Montesa Park for conditioning and additional processing prior to disposal by landspreading. Transportation to Montesa Park will be by four 5,000 gal capacity tank trucks, or by pipeline The proposed truck route is shown in Figure 3-1. The proposed pipeline route includes two pump stations, also shown in Figure 3-1. For alternatives in Group 2 and Group 3, all sludge processing will take place at the treatment facility (i.e., Plant No. 2). After sludge is dewatered as necessary for landfill disposal, it will be transportated by two 20 cu yd end-dump tractor trailers along the general route shown in Figure 5-1. Since the actual landfill site has not yet been determined, the exact truck route cannot be indicated. The shaded area shown in Figure 5-1 is under investigation by the City of Albuquerque for future landfill sites. If dedicated land disposal is implemented, digested liquid sludge will be transported without further processing to the disposal site. Two DLD sites evaluated as optimal sites within this EIS, are Pajarito and Rio Puerco (Figure 5-2). Transportation of liquid sludge to these sites can be accomplished either by truck or by pipeline. If truck transportation is utilized, six 5,000 gal tank trucks will be required to convey the required volume of sludge to the Pajarito site within one working day. Seven trucks will be required for disposal at the Rio Puerco DLD site, due to the additional time required to travel over a longer haul route. A pipeline to Pajarito will require three pump stations and a river crossing, whereas, a pipeline to Rio Puerco will require six pump stations and a river crossing (Figure 5-2).

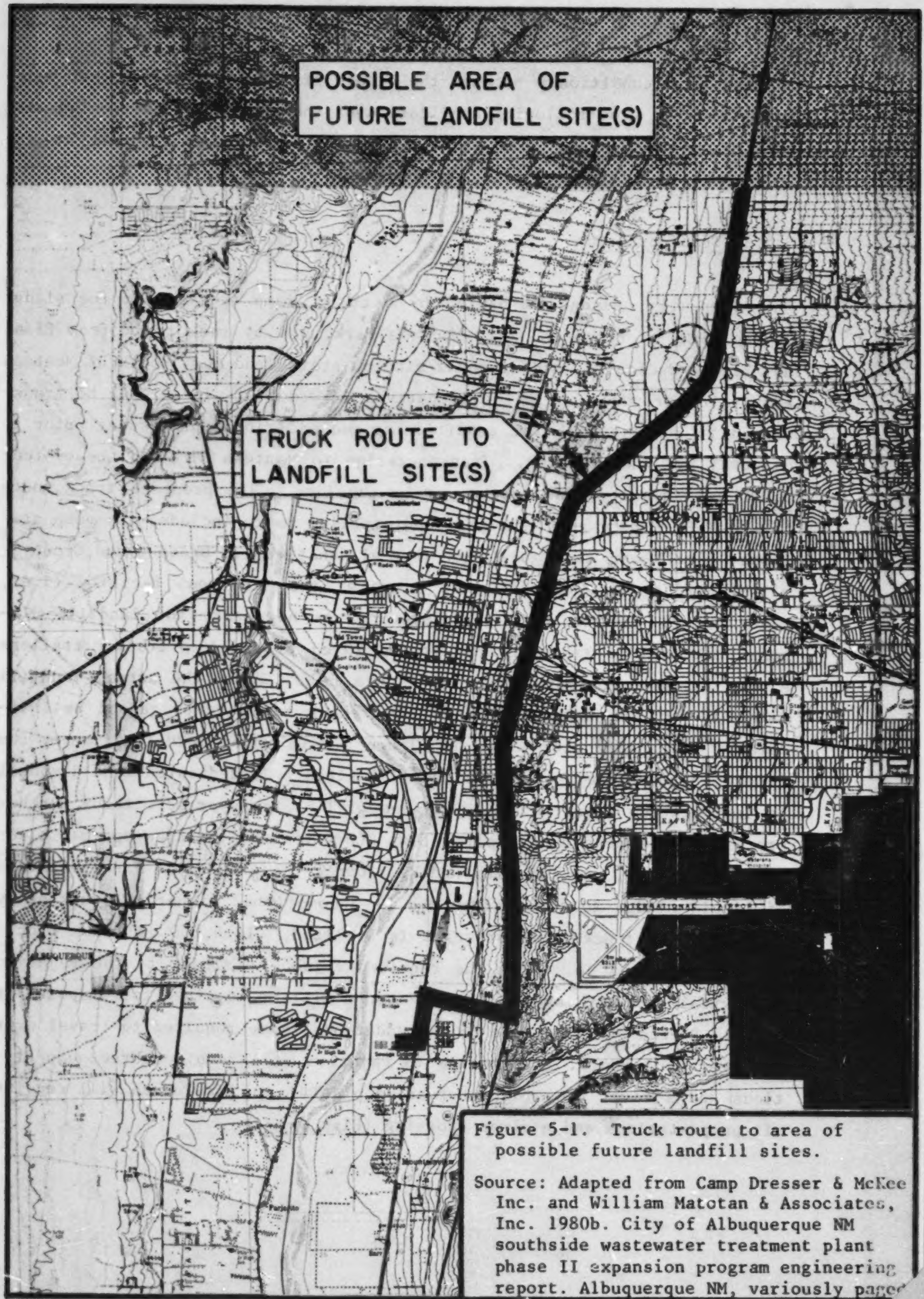

POSSIBLE AREA OF FUTURE LANDFILL SITE(S)
TRUCK ROUTE TO LANDFILL SITE(S)
ALBUQUERQUE
INTERNATIONAL AIRPORT

Figure 5-1. Truck route to area of possible future landfill sites.

Source: Adapted from Camp Dresser & McKee Inc. and William Matotan & Associates, Inc. 1980b. City of Albuquerque NM southside wastewater treatment plant phase II expansion program engineering report. Albuquerque NM, variously paged

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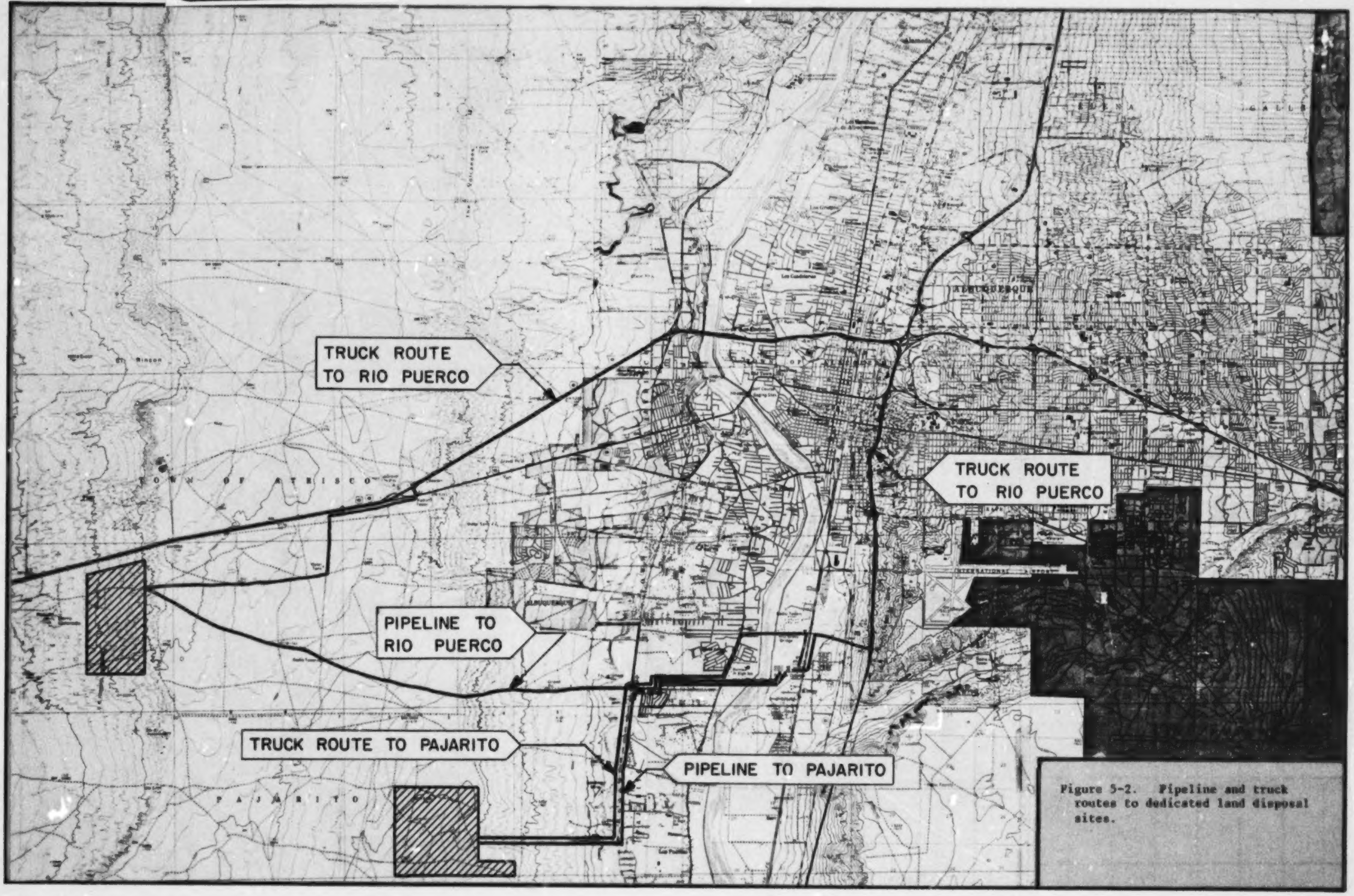
TRUCK ROUTE TO RIO PUERCO
TOWN OF ATRISCO
ALBUQUERQUE
TRUCK ROUTE TO RIO PUERCO
PIPELINE TO RIO PUERCO
TRUCK ROUTE TO PAJARITO
PIPELINE TO PAJARITO
PAJARITO
INTERNATIONAL AIRPORT

Figure 5-2. Pipeline and truck routes to dedicated land disposal sites.

5.5.4 Dewatering

Sludge sand beds located on the western portion of the plant No. 2 site are the current sludge dewatering facilities. A total of 112 beds were constructed between 1962 and the present. The total area of the beds is 508,000 sq ft. At a loading rate of 15 lb/sq ft/yr dry solids, the bed capacity is 3,810 tons of dry solids per year. The 30 newest beds (180,000 sq ft) are lined with plastic membrane, whereas the others are unlined. The existing sand bed capacity is inadequate for current and projected sludge production. Odors emanating from the sand beds have been the reason for citizen complaints and legal court stipulations for several years.

Two optimal options for sludge dewatering that have been considered for the proposed system are belt pressing and pressure filtering. Belt presses typically can accomplish dewatering to 20% or 25% solids, depending on the use of varying amounts of polymer. Sludge to be composted or landfilled need not be dried beyond 20% solids. Open air drying and solar greenhouse drying require sludge input to be at 25% solids. Filter pressing is expected to produce sludge at 35% solids. Dewatering facilities used with Group 1 alternatives (i.e., landspreading) would be located at Montesa Park; dewatering prior to landfilling would be conducted with facilities located at Plant No. 2.

5.5.5 Secondary Drying

Drying sludge beyond the 20-25% solids content obtained by dewatering techniques is not necessary prior to composting, landfilling, or dedicated land disposal, but drying to 40% solids is needed prior to Cesium-137 irradiation. Two optimal drying options are the use of solar greenhouses or open air drying. A combination solar greenhouse/open air drying system can dry 25% solids sludge to 40% solids sludge in approximately 6 days (Wilson & Co. 1981). Two 40 ft by 120 ft open air drying areas would be located in each of three greenhouses. Greenhouses would employ direct gain solar heat, and would not require a heat storage medium. Sludge would be removed from the greenhouses at approximately 35% solids and stockpiled on four 180 ft by 180 ft paved areas (3.0 acres) that would be surrounded by 8-ft walls. After approximately 140 to 150 days, sludge would be removed from the open air stockpile at approximately 40% solids. Figure 5-3 illustrates the proposed site layout for solar drying facilities at Montesa Park. The second drying option is open air drying, consisting of six 50,000 sq ft drying areas (6.9 acres) similar in design to the drying areas that would be used after the solar greenhouses. The sludge would be tilled daily during open air drying. Figure 5-4 illustrates the proposed site layout for open air drying facilities at Montesa Park. The concept of using drying facilities at sites other than Montesa Park was not investigated by the City.

5.5.6 Disinfection

In the past, disinfection was not required prior to the application of sludge on land. The City of Albuquerque has utilized undisinfected sludge on parks and golf courses for many years. This practice was stopped with the promulgation of EPA's current sludge disposal regulations (40 CFR Part 257) requiring disinfection of sludge prior to application on land or incorporation into the soil. For landfilling and dedicated land disposal, anaerobic digestion adequately reduces pathogens if certain restrictions are placed on the use of the site (these restrictions are discussed in more detail in Section 6.11). However, for landspreading on public lands, additional disinfection is now required by EPA regulations. Irradiation using Cesium-137, electron beam irradiation, or composting are the three disinfection options selected for further study.

The City of Albuquerque and the DOE have agreed that DOE will supply Cesium-137, deliver it to the Montesa Park site, install Cesium-137 in an irradiator, and subsequently remove spent Cesium-137 from the site if the Cesium-137 irradiation option is selected. All handling and transportation of Cesium-137 would be carried out by DOE in compliance with all applicable Nuclear Regulatory Commission (NRC) regulations and guidelines, as well as other Federal regulations (Table 3-1). Irradiation would take place in a concrete structure below the ground surface. The Cesium-137 would remain stationary while sludge would be passed through the system. DOE would replenish the Cesium-137 supply periodically, as necessary.

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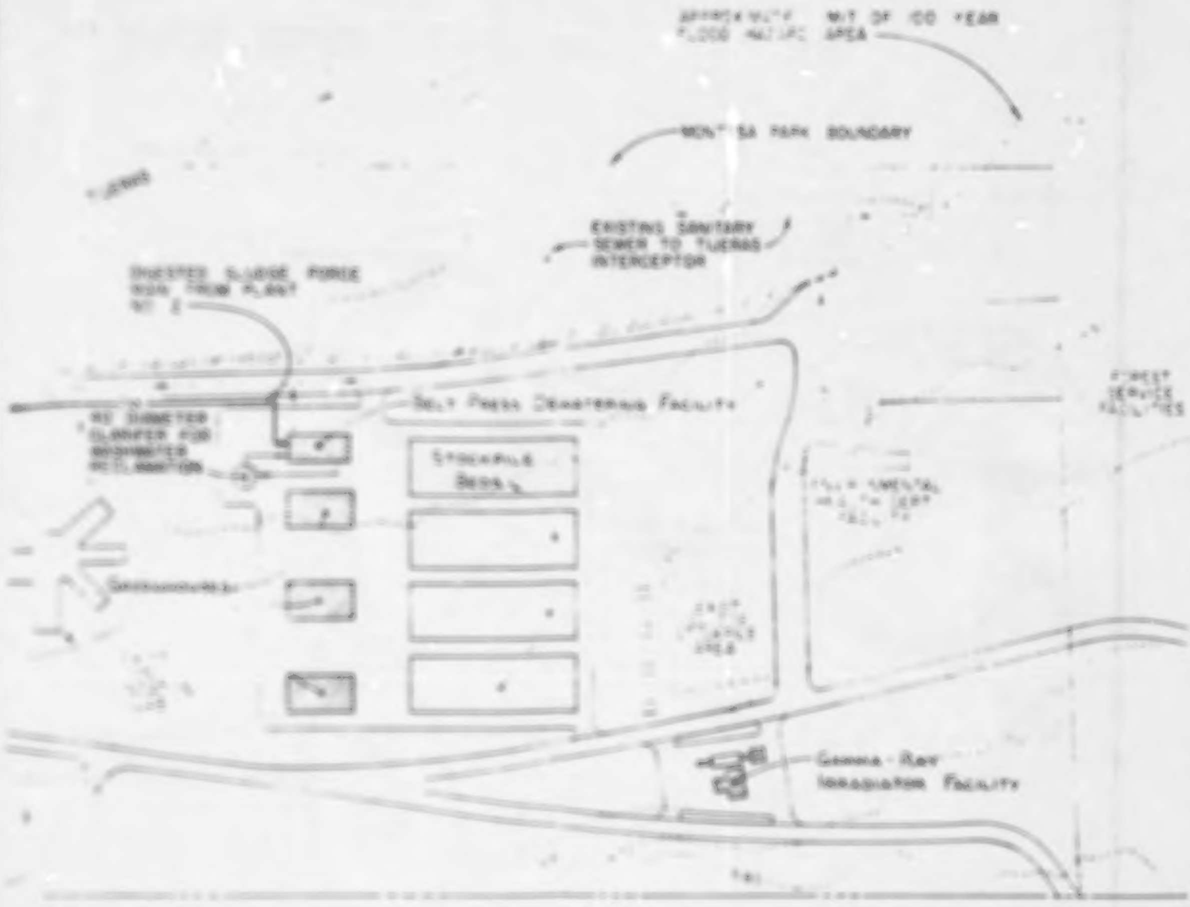

APPROXIMATE LIMIT OF 100 YEAR FLOOD HAZARD AREA
MONTESA PARK BOUNDARY
TIJERAS
EXISTING SANITARY SEWER TO TIJERAS INTERCEPTOR
DIGESTED SLUDGE FORCE MAIN FROM PLANT NO. 2
40' DIAMETER CLARIFIER FOR WASHWATER RECLAMATION
Belt Press Dewatering Facility
FOREST SERVICE FACILITIES
Stockpile Beds
ENVIRONMENTAL HEALTH DEPT FACILITY
Greenhouses
Gamma-Ray Irradiator Facility

Figure 5-3. Site map of Montesa Park - Solar greenhouse/open drying alternative

Source: Adapted from William Matotan & Associates Inc. and Camp Dresser & McKee, Inc. 1980.

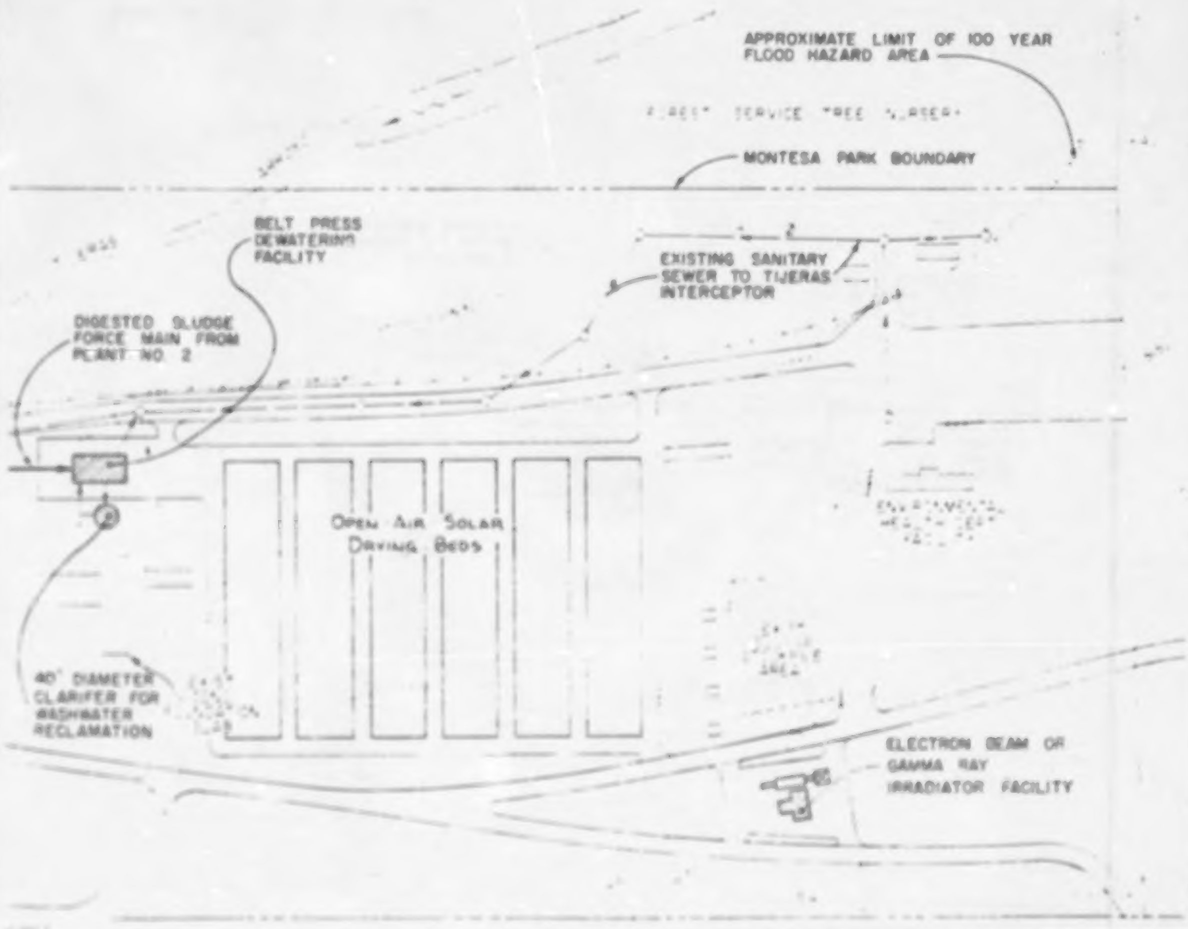

APPROXIMATE LIMIT OF 100 YEAR FLOOD HAZARD AREA
FOREST SERVICE TREE NURSERY
MONTESA PARK BOUNDARY
BELT PRESS DEWATERING FACILITY
EXISTING SANITARY SEWER TO TIJERAS INTERCEPTOR
DIGESTED SLUDGE FORCE MAIN FROM PLANT NO. 2
Open Air Solar Drying Beds
ENVIRONMENTAL HEALTH DEPT FACILITY
40' DIAMETER CLARIFER FOR WASHWATER RECLAMATION
ELECTRON BEAM OR GAMMA RAY IRRADIATOR FACILITY

Figure 5-4. Site map of Montesa Park - open air drying alternatives.

Sources: Adapted from William Matotan & Associates Inc., and Camp Dresser & McKee, Inc. 1980.

Electron beam irradiation probably would take place prior to dewatering, although irradiation of sludge at 20% solids is possible. A thin stream of liquid sludge would pass through an electron beam field generated by a high energy source. The irradiation process would take place in a structure above ground. Cesium and electron beam irradiation facilities are illustrated in Figures 5-3 and 5-4. Utilization of irradiation facilities at sites other than Montesa Park was not evaluated by the City.

The optimal composting option is static pile composting, in which air is circulated through a sludge pile using a forced draft piping system. The static composting process requires approximately 8 weeks. Composting would consist of a 519 cu yd mixing pad where bulking agent is added, a belt conveyor, a 90 ft long by 10 ft high static pile, a 15,570 cu yd curing pad, a 66,074 cu yd storage area, a 35,733 cu yd storage area, and a 30,341 cu yd storage area. Figure 5-5 illustrates a site layout for composting facilities at Montesa Park. Alternate sites for using composting facilities were not evaluated by the City.

5.5.7 Disposal

Landspreading, landfilling, and dedicated land disposal are the three optimal sludge disposal options evaluated in detail by the EIS process. Under landspreading, disinfected sludge would be stockpiled at Montesa Park until the Parks Department could pick it up for use as a fertilizer and soil conditioner on city parks and golf courses. This EIS does not include an analysis of the costs or environmental effects associated with sludge handling or management by the Parks Department.

The exact location of a landfill that would receive sludge if the landfilling option was selected cannot be specified in this document. This is because the landfill presently used by the City will reach capacity in two or three years. Thus, any landfill operations associated with the City's sludge management program would involve use of a new municipal landfill facility to be constructed and operated by the City. It is likely that the new landfill will be located in the area shown in Figure 5-1. The new facility could handle all municipal and commercial waste generated in

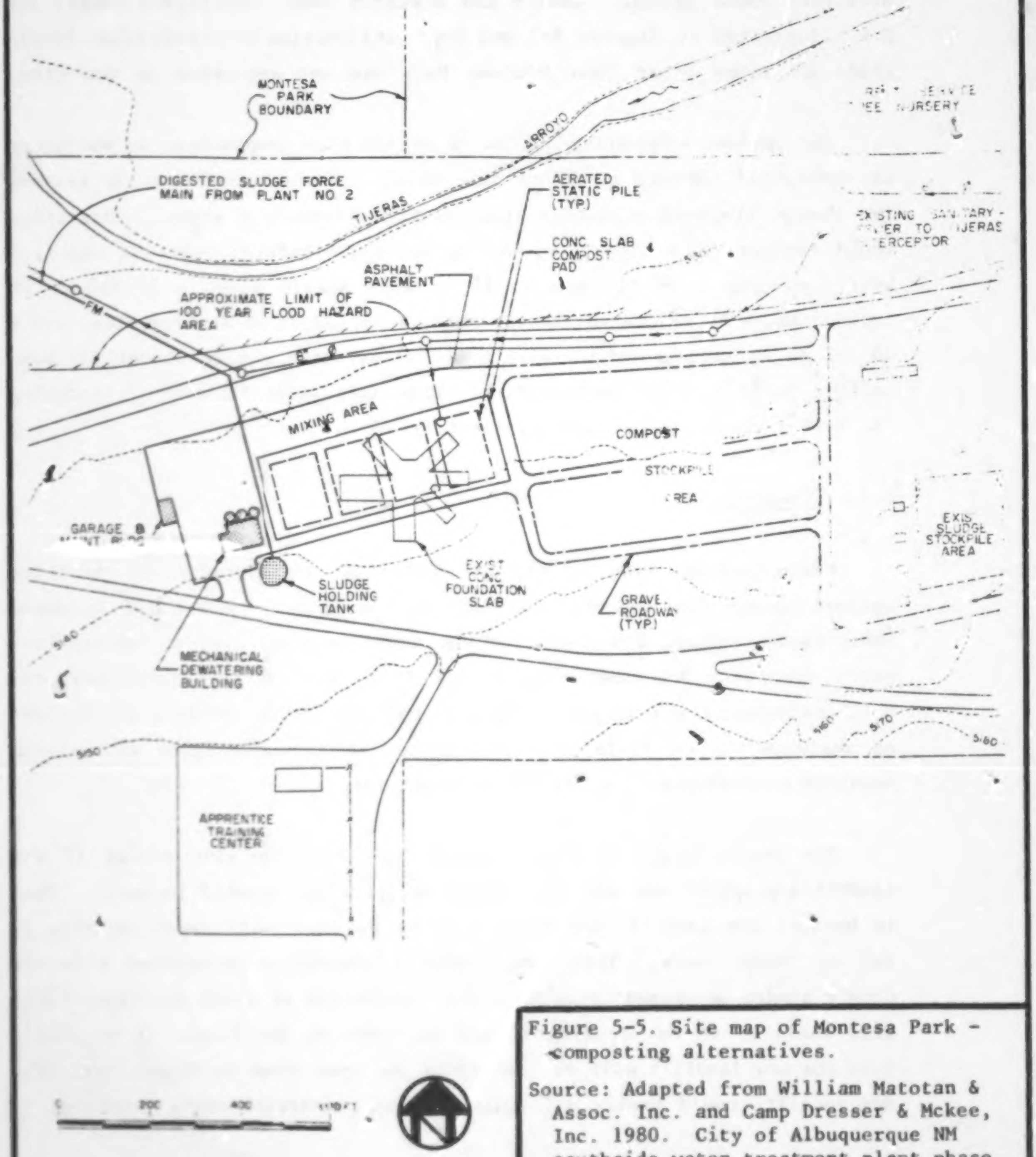

MONTESA PARK BOUNDARY
ARROYO
TIJERAS
DIGESTED SLUDGE FORCE MAIN FROM PLANT NO 2
AERATED STATIC PILE (TYP.)
CONC. SLAB COMPOST PAD
ASPHALT PAVEMENT
APPROXIMATE LIMIT OF 100 YEAR FLOOD HAZARD AREA
FM
MIXING AREA
COMPOST STOCKPILE AREA
EXISTING SANITARY SEWER TO TIJERAS INTERCEPTOR
TREE NURSERY
GARAGE & MAINT BLDG
SLUDGE HOLDING TANK
EXIST CONC FOUNDATION SLAB
GRAVEL ROADWAY (TYP.)
EXIST SLUDGE STOCKPILE AREA
MECHANICAL DEWATERING BUILDING
APPRENTICE TRAINING CENTER
5140
5150
5160
5170
5180
0
200
400

Figure 5-5. Site map of Montesa Park - composting alternatives.

Source: Adapted from William Matotan & Assoc. Inc. and Camp Dresser & Mckee, Inc. 1980. City of Albuquerque NM southside water treatment plant phase II expansion engineering report. Albuquerque NM, variously paged.

the county, as well as municipal treatment sludge from Plant No. 2. It is not anticipated that the sludge will be classified as hazardous waste pursuant to the Resource Conservation and Recovery Act (RCRA), because of the expected success of recent City ordinances requiring industrial pretreatment of liquid wastes. Therefore, the landfill would be designed and operated in compliance with state and Federal standards for non-hazardous solid waste disposal facilities. These standards are designed to protect groundwater, surface water, air, public health, and the aesthetic environment.

Dedicated land disposal operations at Pajarito or Rio Puerco would consist of a 3,580 acre (ac) facility. Figure 5-2 illustrates the locations of the DLD sites and associated transportation routes. Sludge would be injected into shallow furrows and immediately covered with soil. The process would progress incrementally across the entire area, and then be repeated continuously through the 20 yr life of the project. Because state and Federal regulations concerning the accumulation of cadmium, nitrogen, and PCBs in the soil would be observed, it would be possible to sell the land for future use, with possible restrictions on the growth of food-chain crops.

Table 5-11 lists significant characteristics and categories of potential environmental effects for each component option. Detailed evaluations of environmental effects anticipated for each alternative (i.e., combination of component options) are presented by discipline in Chapter 6.0 of this EIS.

5.6 DESCRIPTION OF OPTIMAL ALTERNATIVES

Combinations of options for each of the eight components discussed in Section 5.5 were arranged into a total of 14 optimal alternatives. These optimal alternatives are arranged in three groups according to the method of ultimate disposal of sludge. Table 5-12 lists the component options for each alternative. Currently, alternative 1B is the alternative preferred by the grant applicant (i.e., the City of Albuquerque). Figures 5-6 through 5-8 inclusive are schematic illustrations depicting the process trains associated with each alternative group.

Table 5-11. Potential environmental concerns associated with each optimal component option evaluated for the Albuquerque sludge management program.

COMPONENT	OPTION	SIGNIFICANT CHARACTERISTICS	CATEGORY POTENTIALLY AFFECTED
Thickening	Dissolved Air Flotation	Emissions may contain volatile organics	Air
Stabilization	Anaerobic Digestion	Supernatant return may cause treatment plant upsets	Surface water
Conditioning	Polymer	Toxic in high concentrations	Operator safety
	Lime/$FeCl_3$	Increases sludge production	(Depends on disposal option)
Transportation	Truck	Increased traffic, noise, and exhaust; fuel consumption	Public safety, nuisance, air, energy
	Pipeline	Traffic disruption, noise, dust during construction; possible leaks to soil (or river at crossing); energy required for lift stations	Public safety, nuisance, air, groundwater, surface water, energy
Dewatering	Belt Press	None significant	None significant
	Filter Press	None significant	None significant
Drying	Solar Greenhouse	Buildings and air drying require significant land area; may generate fugitive dust; odor	Land, aesthetics, surface water, groundwater, air, nuisance
	Open Air	Same as solar greenhouse but no building and much more land required	Same as solar greenhouse

Table 5-11. Potential environmental concerns associated with each optimal component option evaluated for the Albuquerque sludge management program (concluded).

COMPONENT	OPTION	SIGNIFICANT CHARACTERISTICS	CATEGORY POTENTIALLY AFFECTED
Disinfection	Cesium-137	Gamma ray irradiation	Public health
	Composting	Large land requirement; dust; odor; possible leachate, possible insect attraction and, therefore bird strike hazard	Land, aesthetics, surface water, groundwater, air, airplane safety
	Electron Beam Irradiation	Energy requirement; ionizing effect on cell molecules	Energy, operator safety
Disposal	Landspreading	Soil contamination by high nitrate, PCBs, and metals; leachate; odor after rains	Surface water, soil, groundwater, aesthetics
	Landfilling	Leachate; land use; aesthetically displeasing	Groundwater, surface water, aesthetics
	Dedicated Land Disposal	Leachate; land use; odor, aesthetically displeasing; soil contamination	Groundwater, surface water, aesthetics

Table 5-12. Sludge management alternatives.

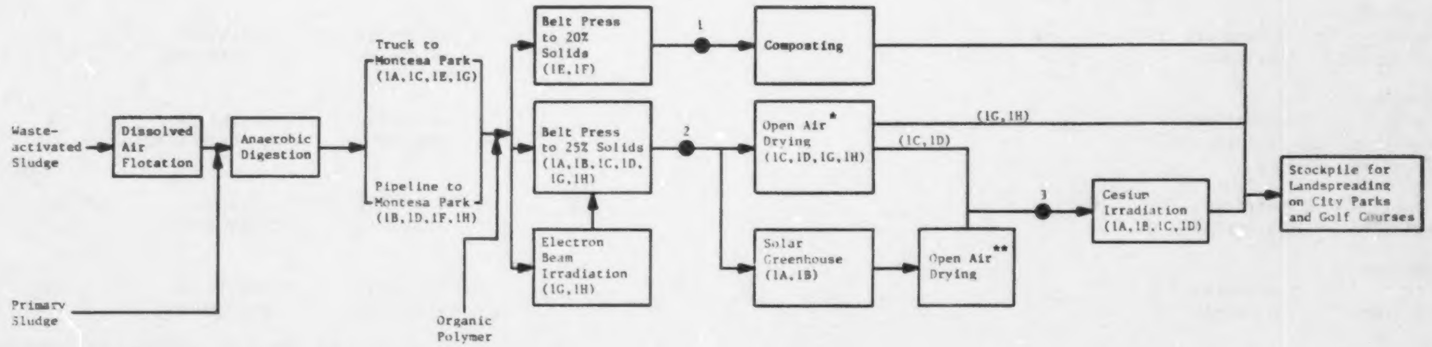
Group 1 - Landspread Concept

NO.	ALTERNATIVE	THICKENING	STABILIZATION	TRANSPORTATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	DISPOSAL
1	1A	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Solar Greenhouse to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
2	1B	Dissolved Air Flotation	Anaerobic Digestion	Pipeline to Montessa Park	Organic Polymer	Belt Press to 25%	Solar Greenhouse to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
3	1C	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
4	1D	Dissolved Air Flotation	Anaerobic Digestion	Pipe to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Cesium-137 Irradiation	Landspread on City Parks and Golf Courses
5	1E	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 20%	——	Composting	Landspread on City Parks and Golf Courses
6	1F	Dissolved Air Flotation	Anaerobic Digestion	Pipeline to Montessa Park	Organic Polymer	Belt Press to 20%	——	Composting	Landspread on City Parks and Golf Courses
7	1G	Dissolved Air Flotation	Anaerobic Digestion	Truck to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Electron Beam Irradiation	Landspread on City Parks and Golf Courses
8	1H	Dissolved Air Flotation	Anaerobic Digestion	Pipe to Montessa Park	Organic Polymer	Belt Press to 25%	Open Air Drying to 40%	Electron Beam Irradiation	Landspread on City Parks and Golf Courses

Table 5-12. Sludge management alternatives (concluded).

NO.	ALTERNATIVE	THICKENING	STABILIZATION	CONDITIONING	DEWATERING	DRYING	DISINFECTION	TRANSPORTATION	DISPOSAL
Group 2 - Landfill Concept									
9	2A	Dissolved Air Flotation	Anaerobic Digestion	Polymer	Belt Press to 20%	—	—	Truck to Landfill	Landfill
10	2B	Dissolved Air Flotation	Anaerobic Digestion	Lime/Ferric Chloride	Pressure Filters to 35%	—	—	Truck to Landfill	Landfill
Group 3 - Dedicated Land Disposal Concept									
11	3A	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Truck to Pajarito	Dedicated Land Disposal
12	3B	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Pipeline to Pajarito	Dedicated Land Disposal
13	3C	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Pipeline to Rio Puerco	Dedicated Land Disposal
14	3D	Dissolved Air Flotation	Anaerobic Digestion	—	—	—	—	Truck to Rio Puerco	Dedicated Land Disposal

— Not Applicable


Waste-activated Sludge
Dissolved Air Flotation
Primary Sludge
Anaerobic Digestion
Truck to Montesa Park (1A,1C,1E,1G)
Pipeline to Montesa Park (1B,1D,1F,1H)
Organic Polymer
Belt Press to 20% Solids (1E,1F)
Belt Press to 25% Solids (1A,1B,1C,1D, 1G,1H)
Electron Beam Irradiation (1G,1H)
1
2
Composting
Open Air* Drying (1C,1D,1G,1H)
Solar Greenhouse (1A,1B)
Open Air** Drying
(1G,1H)
(1C,1D)
3
Cesium Irradiation (1A,1B,1C,1D)
Stockpile for Landspreading on City Parks and Golf Courses

( ) = Alternative number

1 = Stockpile No. 1 - 20% solids

2 = Stockpile No. 2 - 25% solids

3 = Stockpile No. 3 - 40% solids

* = Dry from 25% to 40% solids on six 1.15 acre beds

** = Dry from 35% to 40% solids on four 0.74 acre beds

Figure 5-6. Alternate group number one.

5

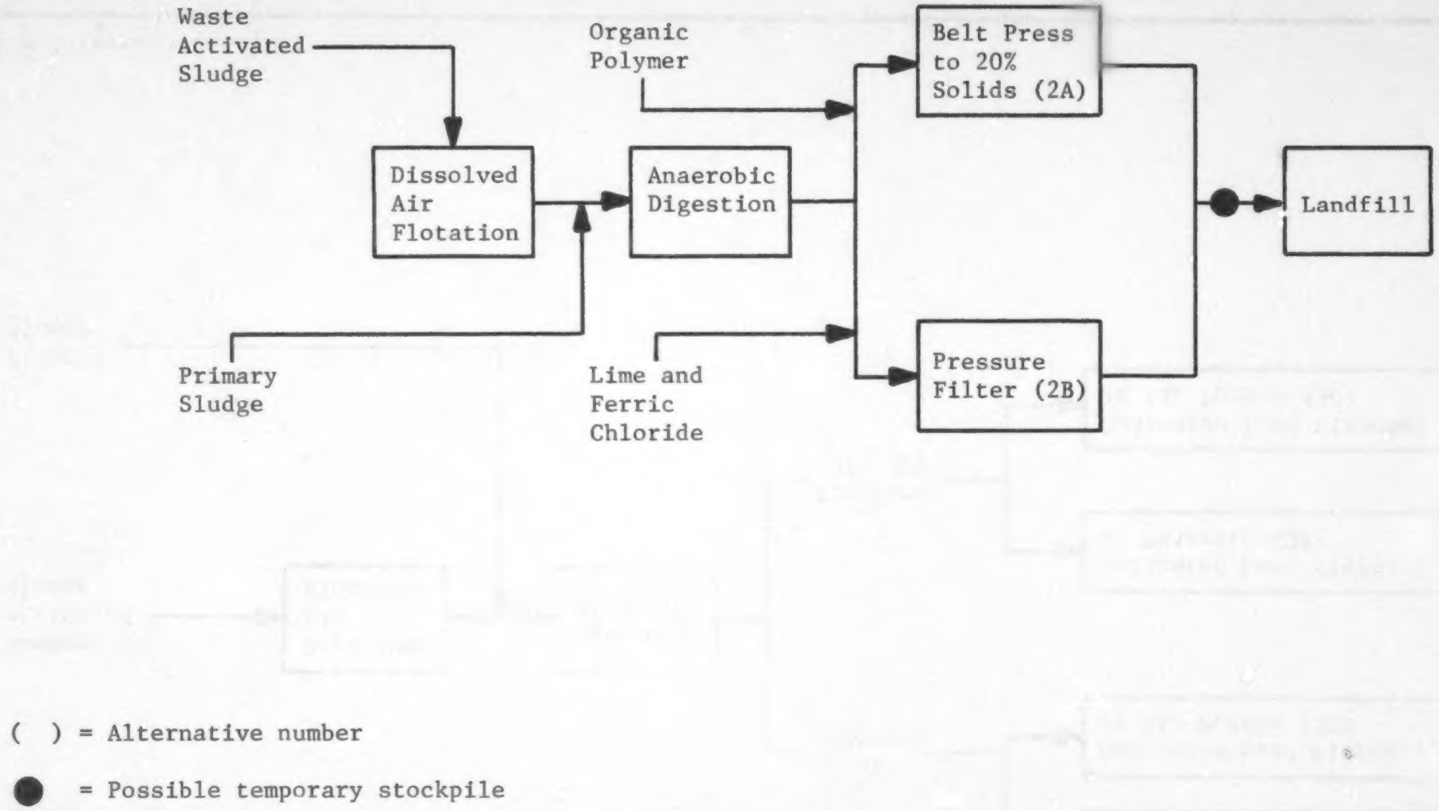
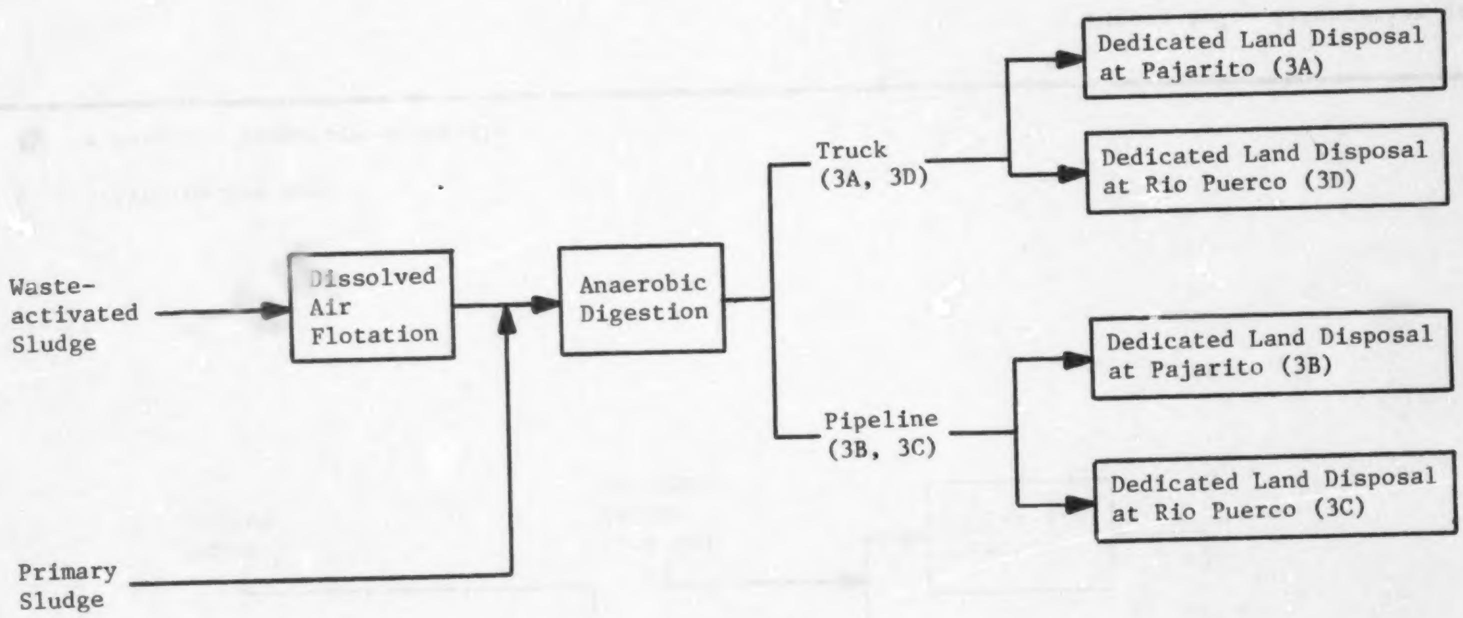

Waste Activated Sludge
Dissolved Air Flotation
Primary Sludge
Anaerobic Digestion
Organic Polymer
Lime and Ferric Chloride
Belt Press to 20% Solids (2A)
Pressure Filter (2B)
Landfill
( ) = Alternative number
● = Possible temporary stockpile

Figure 5-7. Alternative group number two.


Waste-
activated
Sludge
Primary
Sludge
Dissolved
Air
Flotation
Anaerobic
Digestion
Truck
(3A, 3D)
Pipeline
(3B, 3C)
Dedicated Land Disposal
at Pajarito (3A)
Dedicated Land Disposal
at Rio Puerco (3D)
Dedicated Land Disposal
at Pajarito (3B)
Dedicated Land Disposal
at Rio Puerco (3C)

( ) = Alternative number

Figure 5-8. Alternative group number three.

5.7 COST-EFFECTIVENESS ANALYSIS

The City of Albuquerque developed information concerning the anticipated costs of building their preferred alternative or other alternatives (construction cost); the total project cost including engineering, contingency, and administrative fees which will be incurred (capital cost); the estimated cost of operating and maintaining the facilities (annual O&M); and the value treatment equipment will have at the end of the 20-year planning period (salvage value). The City also prepared and submitted to EPA a tabulation comparing the costs of various sludge management alternatives. In addition, the City submitted information to document the value of the sludge as $70 per ton. This was based upon the fact that materials costing at least $70/ton would have to be purchased for replacement fertilizers if sludge was not available for use on public lands.

A letter submitted from the City Parks Department to EPA verified that the Parks Department does value the use of sludge on city parks and golf courses, and is committed to utilizing a substantial portion (approximately 65%) of the sludge that will be produced during the 1990 design year. The City's facilities plan amendment also lists other areas (i.e., lands owned by the University of New Mexico, the State Highway Department, and others) that potentially are available for utilization of the remaining sludge for landspreading activities. Documentation that these other entities are willing to purchase sludge or utilize their lands for landspreading activities has not been provided to-date.

The fact that sludge is a valuable resource is well documented. The City of Largo FL at one time sold its sludge at $4.00 per 50 lb bag (or $160.00/ton), and currently sells its sludge wholesale to a fertilizer manufacturer for $76.00/ton. The City of Houston TX sells its sludge in bulk (railroad cars) for $38.00/ton to a marketing company in Florida. In addition, the City of Los Angeles CA sells its sludge to a fertilizer manufacturer for $5.00/ton. Thus, the value of sludge produced at each of these cities is determined by its actual market value, and the cost of operating the sludge management system in each of these cities is partially offset by the revenues received from the sale of the sludge. However, EPA is not convinced that the City of Albuquerque's sludge will be worth $70/ton, since the City's preferred plan calls for self-utilization of a majority of the sludge, and not for the open-market sale of sludge to generate offsetting revenues.

EPA has evaluated and revised the cost information provided by the City and placed the results in tabular form to present a comparison of the total present worth and total annual equivalent costs of each of the 14 alternatives evaluated in detail. Table 5-13 lists the total costs associated with each alternative, without any credit given for the value of sludge placed upon public lands. Table 5-14 lists the total costs assocated with each alternative with a credit of $70/ton allowed for each alternative that would involve the utilization of sludge for landspreading on public lands. Tables 5-15 through 5-17 inclusive present the local cost that will be incurred by the City of Albuquerque and the equivalent monthly user cost per connection for the 14 alternatives. The equivalent monthly cost per connection figure is not intended to represent the amount each family's monthly water/sewer bill will increase, since monthly water/sewer rate charges can be determined by the City only after all bond sales and other financial programs associated with the sludge management program are finalized. In addition, the salvage value (if any) of the sludge treatment facilities constructed by the City will not be realized until the end of the economic planning period (i.e., year 2004) is reached, and thus will not be available to offset the bonded indebtedness and operational expenses of the system during the planning period (1984-1990). The equivalent monthly cost per connection information is provided only to allow for a meaningful comparison of alternatives. The tables assume the following funding scenarios:

Table 9-15. Cost-effectiveness analysis of optimal alternatives, without a credit given for utilization as sludge on public lands.

Optimal Alternative	Ranking	Capital Cost	Annual O & M	P. W. O & M (10.2921)	Salvage Value	P. W. Salvage (.2379)	Total P. W.	Total Annual Equivalent (.0972)
1A	15	$27,565,100	$1,666,900	$17,155,900	$1,567,500	$ 372,900	$44,348,100	$4,308,900
1B	10	26,353,100	1,621,000	16,683,200	3,655,700	869,700	42,166,600	4,097,000
1C	9	24,208,100	1,645,500	16,935,700	157,100	37,400	41,106,400	3,993,900
1D	5	24,816,100	1,423,300	14,642,900	2,247,600	534,700	38,924,300	3,781,900
1E	14	20,399,000	2,705,900	27,849,500	(3,203,600)	(762,200)	49,010,700	4,762,000
1F	7	21,209,000	1,763,100	18,145,900	(1,107,200)	(263,400)	39,618,300	3,849,400
1G	11	24,153,000	1,800,000	18,525,800	83,600	19,900	42,658,900	4,144,800
1H	8	24,931,000	1,557,800	16,033,100	2,164,500	516,700	40,447,400	3,929,900
2A	2	17,858,700	1,553,900	15,993,200	1,365,300	324,200	33,527,700	3,257,600
2B	1	18,117,100	1,311,300	13,496,100	2,031,500	483,300	31,129,900	3,024,600
3A	6	28,922,400	1,229,700	12,656,200	8,993,700	2,139,600	39,439,000	3,832,000
3B	12	31,281,900	1,476,100	15,192,200	12,667,000	3,013,600	43,460,500	4,222,700
3C	3	28,667,300	936,000	9,633,400	7,600,800	1,806,300	36,494,400	3,545,900
3D	4	25,421,900	1,328,300	13,671,000	3,297,000	794,400	38,298,500	3,721,100

Table 5-14. Cost-effectiveness analysis of optimal alternatives, with a credit (10,740 ton/yr at $70/ton) given for utilization of sludge on public lands.

Optimal Alternative	Ranking	Capital Cost	Annual O & M	P. W. O & M (10.2921)	Salvage Value	P. W. Salvage (.2410)	Total P. W.	Total Annual Equivalent (.0972)
1A	10	$27,565,100	$ 915,100	$9,418,300	$1,547,500	$ 372,900	$36,610,500	$3,557,100
1B	7	28,373,100	672,900	6,925,600	3,609,400	869,700	34,429,000	3,345,200
1C	5	24,208,100	893,700	9,198,100	157,100	37,800	33,368,400	3,242,100
1D	2	25,016,100	651,500	6,705,300	2,219,000	534,700	31,186,700	3,030,100
1E	13	20,399,000	1,954,100	20,111,800	(3,163,400)	(762,200)	41,273,000	4,010,100
1F	3	21,137,000	979,100	10,077,000	(1,101,500)	(265,400)	31,479,400	3,058,600
1G	8	24,153,000	1,048,200	10,788,200	82,600	19,900	34,921,300	3,393,000
1H	4	24,931,000	806,000	8,295,500	2,144,500	516,700	32,709,800	3,178,100
2A	6	17,956,700	1,544,400	15,895,200	1,345,300	324,200	33,527,700	3,257,600
2B	1	18,117,100	1,311,300	13,496,100	2,005,900	483,300	31,129,900	3,024,600
3A	12	28,922,400	1,229,700	12,656,200	8,879,700	2,139,600	39,439,000	3,832,000
3B	14	31,281,900	1,476,100	15,192,200	12,507,000	3,013,600	43,460,500	4,222,700
3C	9	28,665,300	936,000	9,633,600	7,488,000	1,804,500	36,494,400	3,545,900
3D	11	25,421,900	1,328,300	13,671,000	3,297,000	794,400	38,298,500	3,721,100

Table 3-15. Local share of component costs based on 75/85% EPA funding and 12.5% State funding.

Alternative Number	Capital (Local Share)	PV of O&M	PV of Salvage	Total PV	Total Annual (0.0972)	Equivalent Monthly Cost Per Connection* (Sludge = $0/T)	(Sludge = $70/T)**
1A	3,022,434	17,155,900	372,900	19,805,434	1,925,090	1.60	0.97
1B	3,194,154	14,663,200	869,700	16,987,654	1,651,200	1.38	0.75
1C	2,602,829	16,935,700	37,800	19,500,729	1,895,471	1.58	0.95
1D	2,774,529	14,442,900	534,700	16,682,729	1,621,561	1.35	0.72
1E	2,549,877	27,849,500	(762,200)	31,161,577	3,028,905	2.52	1.89
1F	2,721,587	18,145,900	(265,400)	21,132,887	2,054,117	1.71	1.08
1G	3,019,127	18,525,800	19,900	21,525,027	2,092,233	1.74	1.11
1H	3,190,827	16,033,100	516,700	18,707,227	1,818,342	1.52	0.89
2A	2,244,714	15,895,200	324,200	17,815,714	1,731,680	1.44	0.81
2B	2,264,639	13,496,100	483,300	15,277,439	1,484,967	1.24	0.61
3A	7,805,993	12,456,200	2,139,600	18,122,593	1,761,516	1.47	0.84
3B	8,046,743	15,192,200	3,013,600	20,225,343	1,965,903	1.64	1.01
3C	5,650,627	9,633,400	1,806,500	13,477,527	1,310,016	1.09	0.46
3D	4,997,239	13,671,000	794,400	17,873,839	1,737,337	1.45	0.82

* For alternatives 1A, 1B, 1C, and 1D, full funding of Gamma Irradiator by DOE will reduce cost per connection by $0.02 per month.

** $(\$70/\text{T})(10{,}760\text{T/yr})(1\ \text{yr}/12\ \text{mo})\left(\frac{1}{100{,}000\ \text{connections}}\right) = \$0.63$/month-connection credit.

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Table 3-18. Cost per month per connection with 50% EPA funding and 12.5% State funding.

Alternative Number	Capital (Local Share)	PW of O&M	PW of Salvage	Total PW	Total Annual (0.0972)	Equivalent Monthly Cost Per Connection* (Sludge = $0/T)	Equivalent Monthly Cost Per Connection* (Sludge = $70/T)**
1A	6,946,329	17,155,900	372,900	23,729,329	2,499,900	2.08	1.45
1B	9,299,829	14,663,200	869,700	23,093,329	2,244,672	1.87	1.24
1C	7,687,454	16,935,700	37,800	24,585,354	2,388,700	1.99	1.36
1D	8,040,954	14,442,900	534,700	21,949,154	2,133,458	1.78	1.15
1E	7,649,627	27,849,500	(762,200)	36,261,327	2,551,600	2.94	2.31
1F	8,003,127	18,145,900	(265,400)	26,414,427	2,567,482	2.14	1.51
1G	9,057,377	18,525,800	19,900	27,563,277	2,678,100	2.23	1.60
1H	9,210,877	16,033,100	316,700	24,927,277	2,422,931	2.02	1.39
2A	6,734,139	15,895,200	324,200	22,305,139	2,167,200	1.81	1.18
2B	6,796,539	13,494,100	483,300	19,807,339	1,924,500	1.60	0.97
3A	13,998,402	12,636,200	2,139,600	24,495,002	2,380,914	1.98	1.35
3B	14,966,652	15,192,200	3,013,600	27,145,252	2,638,518	2.20	1.57
3C	12,224,877	9,633,400	1,804,500	20,053,777	1,949,227	1.62	0.99
3D	10,875,714	13,671,000	794,400	23,752,314	2,308,725	1.92	1.29

* For alternatives 1A, 1B, 1C, and 1D, full funding of Gamma irradiator by DOE will reduce cost per connection by $0.22 per month.

** $(\$70/t)(10{,}760t/yr)(1\ yr/12\ mo)\left(\frac{1}{100{,}000\ connections}\right) = \$0.63$/month-connection credit.

Revised 8 September 1981

Table 3-17. Cost per month per connection with no EPA funding and 12.5% State funding.

Alternative Number	Capital (Local Share)	PW of O&M	PW of Salvage	Total PW	Total Annual (0.0972)	Equivalent Monthly Cost Per Connection* (Sludge = $0/T)	(Sludge = $70/T)**
1A	22,921,589	17,155,900	372,900	39,704,589	3,859,286	3.22	2.59
1B	23,638,689	14,663,200	869,700	37,432,189	3,638,409	3.03	2.40
1C	19,984,214	16,935,700	37,800	36,882,114	3,584,942	2.99	2.36
1D	20,701,314	14,442,900	534,700	34,609,514	3,364,045	2.80	2.17
1E	17,849,127	27,849,500	(762,200)	46,460,827	4,515,992	3.76	3.13
1F	18,568,227	18,143,900	(265,400)	36,977,527	3,594,216	3.00	2.37
1G	21,133,877	18,525,800	19,900	39,639,777	3,852,986	3.21	2.58
1H	21,850,977	16,033,100	516,700	37,367,377	3,632,109	3.03	2.40
2A	15,712,989	15,895,200	324,200	31,283,989	3,040,804	2.53	1.90
2B	15,852,464	13,496,100	483,300	28,865,264	2,805,704	2.34	1.71
3A	25,933,602	12,656,200	2,139,600	36,450,202	3,542,960	2.95	2.32
3B	28,018,852	15,192,200	3,013,600	40,197,452	3,907,192	3.26	2.63
3C	25,377,376	9,633,400	1,804,500	33,206,276	3,227,650	2.69	2.06
3D	22,512,664	13,671,000	794,400	35,389,264	3,439,836	2.87	2.24

* For alternatives 1A, 1B, 1C, and 1D, full funding of Gamma irradiator by DOE will reduce cost per connection by $0.02 per month.

** $(\$70/T)(10,760T/yr)(1\ yr/12\ mo)\left(\frac{1}{100,000\ connections}\right) = \$0.63$/month-connection credit.

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Table No.	EPA Funding	State Funding
5.15	• 75% of capital cost of most treatment units • 85% of innovative/ alternative units	• 12.5% funding of treatment units
5.16	• 50% funding of treatment units • no innovative/ alternative funding	• 12.5% funding of treatment units
5.17	• no Federal funding	• 12.5% funding of treatment units

A review of the tabulations of equivalent monthly user cost indicates there potentially is a substantial difference in the equivalent user cost associated with various funding scenarios. It has also been stated (but not documented) that DOE may fund the entire cost of constructing a Cesium-137 irradiator, if one is utilized in the chosen sludge management program. If this occurs, then the equivalent monthly user cost associated with alternatives using the Cesium-137 irradiator will decrease by $0.02 per month.

5.8 ALTERNATIVES AVAILABLE TO EPA

Two basic alternatives are available to EPA: (1) issue a grant to the City of Albuquerque, and (2) deny a grant. Denial of a grant constitutes the no action alternative for EPA. A grant can amount to 75% or more of the total cost of an alternative, or can amount to only a part of the cost of an alternative. The effects of EPA implementing either alternative are described in Section 6.13 of this EIS.

5.9 ALTERNATIVES AVAILABLE TO OTHER AGENCIES

The State of New Mexico and the Department of Energy are two other agencies cooperating in this proposed project. The State of New Mexico also has the alternative of providing or denying a grant. The DOE currently is cooperating by providing technical assistance, which they may continue or cancel. In addition, DOE may elected to provide or deny a grant for a Cesium-137 irradiator.

CHAPTER 6.0

ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES ON AFFECTED ENVIRONMENT

6.0 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES ON AFFECTED ENVIRONMENT

This chapter contains information on existing conditions and how the existing conditions will be changed or affected due to the implementation of any one of the 14 optimal alternatives sludge management systems described in Chapter 5.0.

Potential effects of the 14 alternatives are described and evaluated with respect to the following 12 disciplines, or topic categories: earth resources, surface water resources, groundwater resources, air and sound quality, biological resources, cultural resources, population, land use and transportation, economics, energy resources, environmental health, and recreation and aesthetics.

The effects of the Group 1 (landspreading) and Group 3 (dedicated land disposal) alternatives are described and evaluated in a concise and simple manner; however, a brief explanation is needed concerning the evaluation of the effects of the Group 2 (landfill) alternatives. If the City selects an alternative that utilizes landfilling as the ultimate sludge disposal method, then sludge will be disposed in a new municipal landfill, assumedly somewhere north of the City's present landfill. Since the City's present landfill will reach capacity in 2 to 3 years, the City soon will be building a new landfill for solid waste disposal, regardless of how the City's wastewater treatment sludge is disposed. Certain effects or events may occur when the new landfill is built, such as:

- dust may occur due to construction activities;

- noise levels may increase due to landfill construction;

- the topography, or shape of the ground's surface, may be altered due to landfill construction and operation;

- land values in the immediate vicinity of the landfill may be altered; and

- traffic patterns on roadways near the new landfill may be altered due to the presence of garbage trucks going to and from the landfill.

Although these are only a few of the effects that may occur when a new landfill is built, the point of the discussion is this: effects such as those listed above will occur when the new landfill is built regardless of whether sanitary sludge is placed in the landfill or not. Therefore, when describing and evaluating the environmental effects that will occur due to landfilling of sludge, this EIS only describes and evaluates the effects that are associated with the transportation and placement of sludge in the landfill, and not the effects of the landfill activities in general.

Chapter 6.0 concludes with descriptions of the environmental consequences of alternatives available to EPA and other agencies, and with a brief listing of mitigative measures currently being considered by the grant applicant (i.e., the City of Albuquerque) and/or EPA.

6.1 EARTH RESOURCES

6.1.1 Existing Conditions

- Topography

Three distinctive landforms characterize the basic land surface in the Project Region (Bernalillo County): mountain, mesa, and valley. The Sandia Mountains in the eastern part of the county follow a north-south orientation, which parallel the Rio Grande River. The East Mesa is a broad alluvial expanse at the base of the Sandia Mountains. The West Mesa is another broad region in the western part of the county. Both of these areas generally slope downward toward the Inner Rio Grande River Valley located between them. Elevations range from about 4,930 feet in the valley to over 10,000 feet in the Sandia Mountains.

The Sandia Mountains have slopes averaging 25% and local relief exceeding 1,000 feet. The mountains and East Mesa are dissected by large canyons and arroyas with generally steep sides. These canyons and arroyas are naturally formed drainage channels that slope to the west, with larger ones merging with the southward flowing Rio Grande River. The West Mesa is relatively flat and has former volcanic areas whose eastward sloping lava beds often end abruptly in high cliffs. The valley consists of a broad level flood plain on either side of and adjacent to the Rio Grande River. Additionally, a transition area of steeper slopes and terraces occurs between the floodplains and the mesa regions on either side of the river (USEPA 1977).

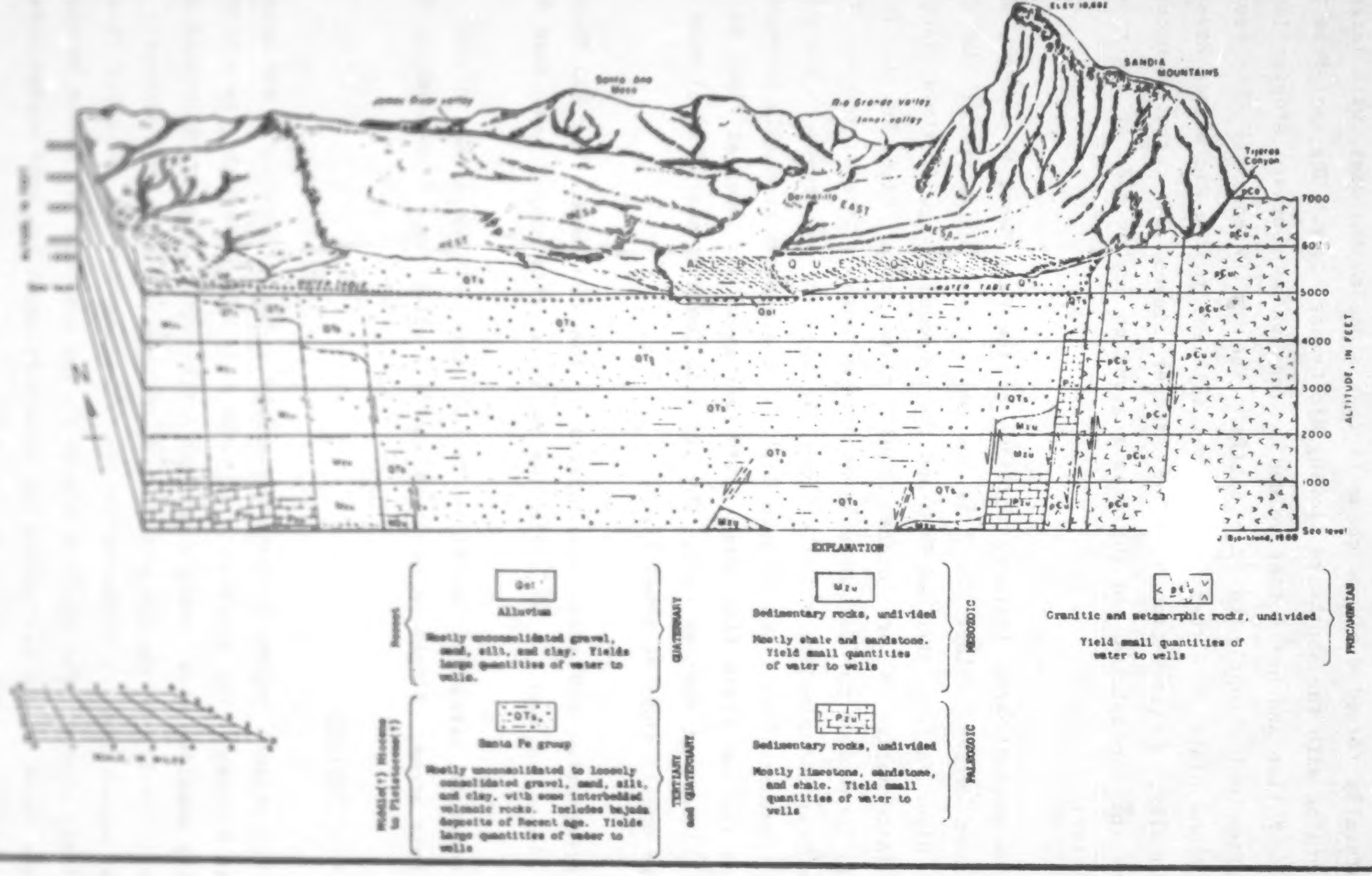
The project area includes portions of the East Mesa, West Mesa, and the Inner Valley. Plant No. 2 is located on the floodplain of the Rio Grande River Valley. Montesa Park and the proposed sewage treatment facilities (Alternative 1B) are located about 5 miles east of Plant No. 2. This area is located on the East Mesa in an arroyo known as Tijeras Arroyo. The City's proposed pipeline travels along the base of the Arroyo to the proposed treatment facilities (Figure 3-1). The elevation gradually increases between the two sites from about 4,930 feet above sea level at Plant No. 2 to 5,150 feet at Montesa Park. The pipeline route is nearly level with an average uphill slope of about 1%.

Alternative DLD sites are located on the West Mesa. The Rio Puerco site slopes as much as 9% while the Pajarito site slopes less than 5%.

Possible sites for landfills include Inner Valley areas as well as West Mesa areas. Slopes on possible landfill sites range from level to 9%.

- Geology

The project region is characterized by a diverse structural and depositional history. The Rio Grande depression (a compound graben) is a structurally subsided area having a general north-south alignment (Bjorklund and Maxwell 1961). In the project region, the depression is approximately 36 miles across and is bordered on the east and west by upfaulted (i.e., uplifted) blocks. The uplifted blocks to the east form the Sandia Mountains and the block to the west forms the generally level highlands approximately 20 miles west of Albuquerque (Figure 6-1).



Sandia Crest
Elev 10,682
SANDIA MOUNTAINS
Tijeras Canyon
Santo Ana Mesa
Jemez River valley
Rio Grande valley
Inner valley
Bernalillo
EAST
MESA
WEST
ALBUQUERQUE
Water table
N
ALTITUDE, IN FEET
7000
6000
5000
4000
3000
2000
1000
Sea level
J. Bjorklund, 1960
QTs
Qal
Mzu
Pzu
pCu
EXPLANATION
Qal
Alluvium
Mostly unconsolidated gravel, sand, silt, and clay. Yields large quantities of water to wells.
Recent
QUATERNARY
QTs
Santa Fe group
Mostly unconsolidated to loosely consolidated gravel, sand, silt, and clay, with some interbedded volcanic rocks. Includes bajada deposits of Recent age. Yields large quantities of water to wells
Middle(?) Miocene to Pleistocene(?)
TERTIARY and QUATERNARY
Mzu
Sedimentary rocks, undivided
Mostly shale and sandstone. Yield small quantities of water to wells
MESOZOIC
Pzu
Sedimentary rocks, undivided
Mostly limestone, sandstone, and shale. Yield small quantities of water to wells
PALEOZOIC
pCu
Granitic and metamorphic rocks, undivided
Yield small quantities of water to wells
PRECAMBRIAN
SCALE, IN MILES

Source: Adapted from Bjorklund, Louis J. and Bruce W. Maxwell. 1961. Availability of groundwater in the Albuquerque area, Bernalillo and Sandoval Counties, New Mexico. Technical report 21. New Mexico State Engineer. Santa Fe, 117 p.

Figure 6-1. Block diagram of the project area and vicinity showing topography, generalized geology, and the water table in the alluvium and the Santa Fe group.

The project area lies within the Rio Grande depression. It is approximately 6 miles west of the fault zone separating the depression from the uplifted Sandia Mountains. The proposed treatment facilities at Montesa Park and the pipeline to Montesa Park occur on valley alluvium associated with depositional processes along Tijeras Arroyo.

Data from wells near the alternative disposal sites indicate the geology at the lower end of Tijeras Arroyo consists of interbedded sand, clay, and gravel in the alluvial material. It is approximately 47% sand, 37% coarse material (gravel), and 16% clay and mixed particles. A thick region of sand occurs between 78 feet and 123 feet below the surface in the alluvial material. The Santa Fe group below the alluvial material consists of 60% clay interbedded with 25% sandy material. The remaining 15% is sandstone and coarse materials.

Geologic data concerning the Montesa Park area show that the Santa Fe group is dominated by various sands which make up approximately 58% of the group. The remaining 42% primarily is gravelly in texture occurs in the upper part of the Santa Fe group. Several feet of finer alluvial material overlie the gravelly zone.

A well between the DLD sites indicates the geology consists of approximately 62% small grained material such as clay, shale, caliche, and intermixed layers of these three. Approximately 37% of the well is sand. The remaining 1% consists of lava rock.

Sand and gravel are dominant (75%) in a well near the landfill zone. The remaining 25% is clay with some small amount of caliche.

- Soils

Three soil associations occur within the Project Area: the Gila-Vinton-Brazito association; the Bluepoint-Kokan association; and the Madurez-Wink association.

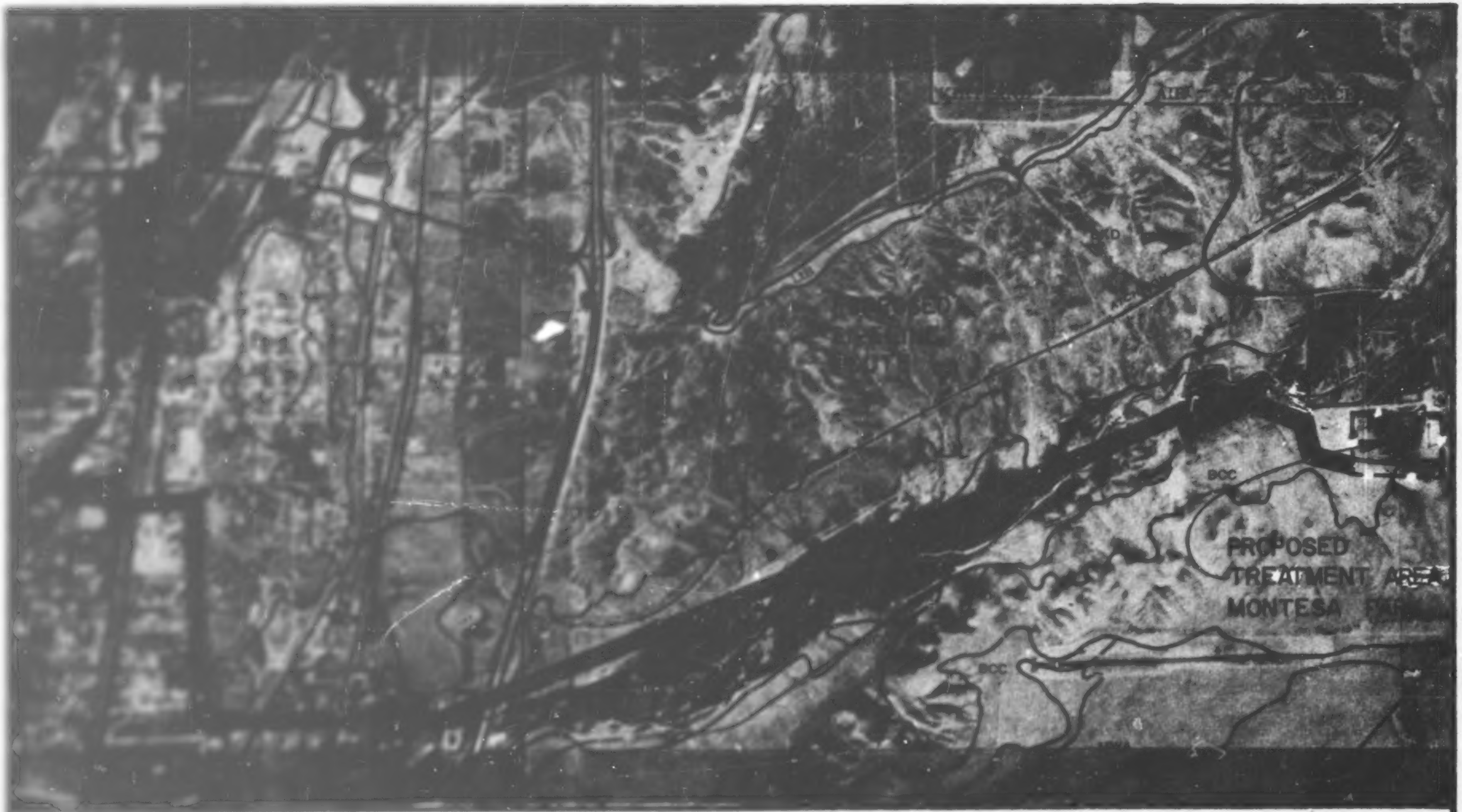
The Gila-Vinton-Brazito association is typified by level to nearly level, well drained loamy soils on the floodplain of the Rio Grande and along the Tijeras Arroyo Valley. Gila soils have a surface layer of calcareous loam, a stratified very fine sandy loam layer underneath the top layer, and thick sand below these layers. Vinton soils have a sandy loam surface with underlying layers of loamy sand and very fine sand. Brazito soils have a silty clay loam surface layer with coarse sand in the subsurface. Some soils of this association have a moderate or high shrink-swell potential. Local areas need protection from flooding.

The Bluepoint-Kokan association is comprised of level to steep excessively drained sandy and gravelly soils on dissected terraces and alluvial fans, mainly along the sides of Tijeras Arroyo. Bluepoint soils are rolling loamy sand soils on broad alluvial fans. Kokan soils are rolling to steep gravelly sand soils located on dissected terraces. The hazard of water erosion is moderate to severe for this association.

The Madurez-Wink association is typically composed of soils that are level to moderately sloping and well drained. In the Project Area these are located above and on either side of Tijeras Arroyo. Madurez soils have a fine sandy loam surface layer and subsoils of sandy clay loam, find sandy loam, and sandy loam. Madurez soils are located in slightly concave upland areas. Wink soils have a surface layer of fine sandy loam and sandy loam underlain by a sandy loam that is high in lime content. Wink soils are located in slightly convex upland areas.

Soils that will be directly affected by construction and operation of the proposed sludge handling facilities at Montesa Park and the proposed pipeline are shown in Figure 6-2. Five soil units that will be affected are described below according to their occurrence along the proposed pipeline route from Plant No. 2 to Montesa Park. Three units are part of the Gila Series, and two units are part of the Bluepoint Series.

The Gila Series (in general for the units labeled Gd, GF and GA) is comprised of deep, well drained soils formed in recent floodplain alluvium of the Rio Grande River. A representative sample shows a loamy surface


BCC
BCC
PROPOSED
TREATMENT ARE
MONTESA PAR

Source: Soil Conservation Service. 1977. Soil survey of Bernalillo County and parts of Sandoval and Valencia Counties, New Mexico. US Department of Agriculture, Washington DC, 101 p.

Figure 6-2. Soil mapping units of the project site. Mapping units defined in Table 6-1.

SCALE: 1:24,000

0
1000
2000
3000

layer seven inches thick. Below the surface layer is a stratified very fine sandy loam and sandy loam layer that is approximately 37 inches thick. Below these two layers is sand to a depth of 60 inches or more. Permeability is moderate and available water capacity is 8 to 11 inches. The pertinent mapping units of the series are: Gd - Gila loam, moderately alkali; GF - Gila complex, moderately alkali; and GA - Gila fine sandy loam. During rainstorms, more water is absorbed than is lost to runoff. Detailed characteristics of these units are presented in Table 6-1.

The Bluepoint Series (in general for the units labeled BCC and BKD) is comprised of deep, somewhat excessively drained soils that formed in sandy alluvial and windblown sediments along the sides of Tijeras Arroyo. A representative sample depicts a surface layer of loamy fine sand eight inches thick. Below the surface layer, to a depth of greater than 60 inches or more is a loamy sand. The soil is slightly calcareous and mildly to moderately alkaline. Permeability is rapid and available water capacity is 4 to 5.5 inches. The pertinent mapping units of this series are: BCC - Bluepoint loamy fine sand (1% to 9% slope) and BKD - Bluepoint-Kokan association, hilly. During rainstorms a much greater amount of water is absorbed than is lost to runoff. Detailed characteristics of these units are also presented in Table 6-1.

The mapping unit at the proposed Rio Puerco DLD sites is the BKD - Bluepoint-Kokan association which is hilly and a part of the Bluepoint Series described in the previous section. The mapping unit at the proposed Pajarito DLD location is MWA - Madurez-Wink association which is gently sloping. Detailed properties of these soils are presented in Table 6-1.

The MWA mapping unit is part of the Madurez Series which consists of deep, well drained soils formed on piedmonts in old unconsolidated alluvium modified by wind. In a representative profile, the surface layer is a fine sandy loam about 4 inches thick. The subsoil is sandy clay loam and find sandy loam about 17 inches thick, sandy loam to a depth of 60 inches.

Additional mapping units listed in Table 6-1 are those likely to be crossed by proposed pipelines or landfills.

Table 6-1. Properties of soil mapping units of alternative project sites.

Soil Series and Mapping Unit[1]	Depth from Surface (inches)	Texture	Slope	Permea-bility[2] (in/hr)	Water Capacity (in/in soil)	pH	Shrink-swell Potential	Shallow Excavation Limits	Hazard	Runoff
Bluepoint:										
BCC, Bluepoint loamy fine sand, 1 to 9% slope	0-8	Loamy fine sand	1-9%	6.0-20	0.07-0.09	7.4-8.4	Low	Severe: Cut-banks cave	Soil blowing: severe	Slow
	8-60	Loamy sand		6.0-20	0.07-0.09	7.4-8.4	Low			
BKD, Bluepoint - Kokan association, hilly, and BcA, Bluepoint loamy fine sand, 1 to 3% slope	0-60	50% Loamy fine sand, 40% gravelly sand, 10% limy	5-40%	6.0-20	0.07-0.09	7.4-8.4	Low	Severe: Cut-banks cave	Water erosion: moderate to severe	Slow
Gila:										
GA, Gila fine sandy loam (5-15% has gravel lenses)	0-7	Loamy	0-2%	0.6-2.0	0.13-0.18	7.9-8.4	Low	Slight	Water erosion and soil blowing: moderate; flooding hazard	Slow
	7-44	Very fine sandy loam & sandy loam		0.6-2.0	0.13-0.18	7.9-8.4				
	44-60	Sand		0.6-2.0	0.05-0.07	7.9-8.4				

Table 6-1. Properties of soil mapping units of alternative project sites (continued).

Soil Series and Mapping Unit[1]	Depth from Surface (inches)	Texture	Slope	Permea-bility[2] (in/hr)	Water Capacity (in/in soil)	pH	Shrink-swell Potential	Shallow Excavation Limits	Hazard	Runoff
Glendale:										
Gk, Glendale loam	0-6	Clay loam or loam	0-1%	0.2-0.6	0.16-0.20	7.4-7.8	Moderate	Moderate: too clayey	Water erosion: slight	Very slow
	6-38	Silt loam		0.2-0.6	0.19-0.21	7.9-8.4	Moderate			
	38-60	Clay loam		0.2-0.6	0.19-0.21	7.4-8.4	Moderate			
Latene:										
LtB, Latene sandy loam, 1 to 5% slopes	0-15	Sandy loam	1-5%	0.6-2.0	0.12-0.14	7.9-8.4	Low	Moderate: small stones	Water erosion, soil blowing: moderate	Medium
	15-60	Gravelly sandy loam		0.6-2.0	0.09-0.11	7.9-8.4	Low			
Vinton:										
Va, Vinton loam sandy	0-10	Sandy loam	0-1%	2.0-6.0	0.10-0.12	7.9-8.4	Low	Severe: cutbanks cave	Soil blowing: severe; water erosion: slight	Very slow to slow
VbA, Vinton sandy, loam, 0 to 1% slopes	10-60	Loamy sand		2.0-6.0	0.06-0.08	7.9-8.4	Low			
VF, Vinton and Brazito soils, occasionally flooded										
Pajarito:										
PAC, Pajarito loamy fine sand, 1 to 9% slopes	0-60	Fine sandy loam and sandy loam		2.0-6.0	0.09-0.11	7.4-8.4	Low	Slight	Soil blowing: severe	Slow

Table 6-1. Properties of soil mapping units of alternative project sites (continued).

Soil Series and Mapping Unit[1]	Depth from Surface (inches)	Texture	Slope	Permea-bility[2] (in/hr)	Water Capacity (in/in soil)	pH	Shrink-swell Potential	Shallow Excavation Limits	Hazard	Runoff
Agua:										
Af, Agua loam	0-10	Loam or silty clay loam	0-1%	0.6-2.0	0.16-0.20	7.9-8.4	Moderate	Severe: cutbanks cave	Erosion: slight	Very slow
	10-24	Loam and very fine sandy loam		0.6-2.0	0.13-0.17	7.9-8.4	Low			
	24-60	Fine sand		6.0-20	0.05-0.07	7.9-8.4	Low			
Anapra:										
An, Anapra silt loam	0-8	Silt loam or silty clay loam	0-1%	0.2-0.6	0.19-0.21	7.9-8.4	Low to moderate	Severe: cutbanks cave	Erosion: slight	Slow
	8-24	Clay loam		0.2-0.6	0.19-0.21	7.9-8.4	Moderate			
	24-60	Sand		6.0-20	0.05-0.07	7.9-8.4	Low			
Embudo:										
Emb, Embudo gravelly fine sandy loam, 0 to 5 percent slopes	0-20	Gravelly fine sandy loam and gravelly sandy loam	Emb: 0-5% Etc. 0-9%	0.6-2.0	0.07-0.09	7.9-8.4	Low	Severe: seepage	Water erosion: moderate	Medium
Etc, Embudo-Tijeras complex, 0 to 9% slopes	20-60	Gravelly loamy coarse sand		Greater than 20	0.04-0.06	7.9-8.4	Low			

Table 6-1. Properties of soil mapping units of alternative project sites (continued).

Soil Series and Mapping Unit[1]	Depth from Surface (inches)	Texture	Slope	Permea-bility (in/hr)[2]	Water Capacity (in/in soil)	pH	Shrink-swell Potential	Shallow Excavation Limits	Hazard	Runoff
Gd - Gila loam, moderately alkali	0-8	Loamy	0-1%	0.6-2.0	0.07-0.12	7.9-9.0	Low	Moderate: Wet	Water erosion: Slight	Slow
	7-44	Very fine sandy loam and sandy loam		0.6-2.0	0.07-0.12	7.9-9.0	Low		Crusts easily	
	44-60	Sand		0.6-2.0	0.07-0.12	7.9-9.0	Low			
GF, Gila complex, moderately alkali (15% gravelly throughout)	0-7	70% loamy sand or sandy loam 15% sandy clay loam	0-2%	0.6-2.0	0.07-0.12	7.9-9.0	Low	Moderate: Wet	Water erosion: moderate; soil blowing: severe	Medium
	7-44	Very fine sandy loam and sandy loam		0.6-2.0	0.07-0.12	7.9-9.0	Low			
	44-60	Sand		0.6-2.0	0.07-0.12	7.9-9.0	Low			
Brazito:										
Br, Brazito fine sandy loam	0-9	Fine sandy loam to silty clay	0-1%	0.6-2.0	0.13-0.21	7.9-8.4	Low to moderate	Severe: cutbanks cave	Erosion: slight	Slow
Bs, Brazito silty clay loam	9-60	Sand		6.0-20	0.05-0.07	7.9-8.4	Low			
Bt, Brazito complex										

Table 6-1. Properties of soil mapping units of alternative project sites (concluded).

Soil Series and Mapping Unit[1]	Depth from Surface (inches)	Texture	Slope	Permea-bility[2] (in/hr)	Water Capacity (in/in soil)	pH	Shrink-swell Potential	Shallow Excavation Limits	Hazard	Runo
Wink:										
WaB, Wink fine sandy loam, 0 to 5% slopes	0-35	Sandy loam	0-5%	2.0-6.0	0.09-0.13	7.9-8.4	Low	Slight	Water erosion: slight to moderate; soil blowing: moderate	Medium
	35-60	Sandy loam		2.0-6.0		7.9-8.4	Low			
Madurez:										
MWA, Madurez Wink association, gently sloping	0-21	Fine sandy loam and sandy clay loam	1-7%	0.6-2.0	0.14-0.16	7.9-8.4	Moderate	Slight	Soil blowing: moderate to severe	Slow
	21-60	Sandy loam		0.6-2.0	0.12-0.14	7.9-8.4	Low			
MaB, Madurez loamy fine sand 1 to 5% slopes	0-9	Loamy fine sand	1-5%	0.6-2.0	0.09-0.11	7.9-8.4	Low	Slight	Soil blowing: severe	Slow
	9-21	Sandy clay loam		2.0-6.0	0.14-0.16	7.9-8.4	Low			
	21-60	Sandy loam		0.6-2.0	0.12-0.14	7.9-8.4	Moderate			

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[1] Main soils at sites: Montesa Park - BCC; Pajarito - MWA; Rio Puerco - BKD; Landfill - Etc; Pipeline to Montesa Park - BCC, GA, Gd, GF; common to pipelines for Pajarito and Rio Puerco - BCC, BKD, Br, Bs, Bt, Af, An, Gk, LtB, Va, VbA, VF, WaB, MWA, MaB; additional to Rio Puerco pipeline - PAC.

[2] Permeability: less than 0.6 in/hr: slow; 0.6-2.0 in/hr: moderate; 2.0-6.0 in/hr: moderately rapid; greater than 6.0 in/hr: rapid.

Source: Soil Conservation Service 1977. Soil survey of Bernalillo County and parts of Sandoval and Valencia Counties, New Mexico. US Department of Agriculture, 101 p.

6.1.2 Environmental Consequences of the No Action Alternative

If the City chooses to take no action, the excess sludge which would be lagooned north of the present Plant No. 2 could adversely impact the soils. Stockpiles at Montesa Park would have some effect also, though not to the extent caused by sludge lagooning at Plant No. 2. Soils will be affected by chemical alterations, including increases in toxic elements such as cadmium, copper, and nitrogen. These effects will occur due to leaching by water infiltration from the surface. However, contaminated soils are not the prime concern, but rather the more significant affects caused if leachate reaches groundwater, (Section 6.3.2) potentially contaminating groundwater supplies.

6.1.3 Environmental Consequences of the Action Alternatives

Of the components (thickening, stabilization, conditioning, etc.) involved in the action alternatives, conditioning, drying, transportation, and disposal are the components that could effect earth resources. Different options are available under each component.

Negative environmental effects associated with these components can be minimized if proper management practices are used. Conversely, if proper management and sludge application monitoring practices are not followed, contamination of soil is potentially significant. Potentially significant effects associated with various treatment and disposal options are discussed below.

- Conditioning

  - Lime/Ferric Chloride (applies to Alternative 10 only).

Use of lime will substantially raise the pH of sludge. This could limit the use of the landfill for future vegetative growth, if that were desired once the landfill is abandoned.

- **Drying**

  - Open Air Drying

The option of open air drying involves stockpiling of sludge at Montesa Park prior to its being disposed of by landspreading. This could potentially be a source of sludge leachate and/or contaminated surface runoff which will degrade soil in the area below and near the stockpiles. However, this should have little significant effect upon humans or other life since plant growth or other soil uses at present are sparse in the Montesa Park area.

- **Disposal**

  - Landspreading

The landspreading alternative involves the intended use of treated sludge as a fertilizer. Dried sludge would be periodically spread on city parks and golf courses in the City of Albuquerque. Effects depend on such things as rates of application, amount applied each application, constituents incorporated in the sludge, and soil characteristics. Accumulation of phytotoxic metals such as cadmium, copper, zinc, and nickel is the prime concern of over-application. To control this problem, safe accumulation limits within a certain time period should be set and the areas spread with sludge monitored for accumulative levels. Limits set would depend on safe uptake of these metals by grasses on the parks. The application rate depends on such things as the cation exchange capacity (CEC) of the affected soil, the soil texture, and the rate of use of elements in the sludge by the affected grasses.

Benefits of landspreading as a soil conditioner are appropriate to the Albuquerque area in general. The generally sandy texture of the soil is improved for vegetative growth by application of sludge. Organic matter added by the sludge generally improves soil tilth. One study has shown digested sludge applied to a sandy soil increased field moisture capacity, non capillary porosity, and cation exchange capacity. Similarly, organic matter content, total nitrogen, and soil aggregation increased significantly Benefits were found to be greater in sandy soil than in loam. (National Academy of Sciences 1977).

Concentration of nutrients that increase soil fertility (nitrogen, phosphorus, and potassium) are considerably lower in sludge than in commercial fertilizers. Therefore, sludge generally needs to be applied very heavily in comparison to commercial fertilizers in order to deliver similar nutrient value. Much of the nitrogen in sludge is organic and is only slowly available to plants since it must first convert to inorganic forms. Phosphorus and potassium are considered to be as available in sludges as in commercial chemical fertilizers (National Academy of Sciences 1977). Thus, if sludge is applied at somewhat conservative rates as compared to its "safe" nutrient limits, there is much less likelihood of soil contamination problems. Similarly, if sludge is applied heavily in order to achieve nutrient values comparable to commercial fertilizers, toxic metals entering soil from the sludge may exceed "safe" limits.

- Landfilling

The alternatives utilizing landfilling involve the use of a refuse landfill for the disposal of sludge from treatment Plant No. 2. Proper construction and management of the landfill in accordance with state and Federal requirements should effectively limit any environmental problems. The importance of this is emphasized due to the sandy and gravelly subsurface in possible landfill areas, which allows for more extensive leaching possibilities. Proper installation of a clay liner will prevent toxic elements from entering the soil or geologic strata outside the landfill boundaries. Nitrates, gases, pathogens, and toxic metals occurring in a landfill emphasize further the importance of its proper construction and the use of a liner. The impact of the disposed sludge is significantly lessened due to the presence of toxic materials already disposed in typical municipal solid waste landfills.

Wind and/or water erosion are potential problems associated with landfill operations. Soil to be used in the landfill operation is likely sandy and easily wind-blown in the Albuquerque area. Water erosion could affect the surrounding area by carrying contaminated surface runoff outside the boundary of clay linings if the topography of the landfill were to rise above the surrounding area.

- Dedicated Land Disposal at Pajarito and Rio Puerco

An additional alternative for sludge disposal involves setting aside a particular land area for the sole purpose of sludge disposal. The upper soil layer is directly affected by the process of plowing and sludge injection. As with other alternatives, careful management practices should make this a viable alternative while adverse affects could result from improper monitoring. The City's description of DLD alternatives do not describe proposed monitoring programs.

One item of environmental concern to earth resources is the affect upon soil productivity at a DLD site. Nothing will grow during active DLD operations, and productivity following its use as a DLD site is questionable. Careful monitoring of toxic elements, following USDA guidelines, should allow for food chain crop growth following the site's use as a disposal area. Copper is the only toxic parameter which, from sludge sampling, exceeds the USDA guidelines. Toxics will build up so that unlimited use of an area following DLD operations will be limited over a period of years (probably between 20 and 30).

Another major environmental concern is water erosion and erosion due to wind blowing. During dry periods severe dust problems are likely in the two barren areas proposed for DLD sites because of the constant plowing and loosening of topsoil.

Lagoons are proposed at the DLD sites to store sludge prior to its application by injection. Since the lagoons will have a concentration of toxics directly received from the treatment plant, they deserve more intensive environmental monitoring than the DLD application area.

A further consideration concerns usefulness of the sludge itself. The potentially beneficial fertilization and soil conditioning characteristics from landspreading are lost by use of the DLD disposal method.

- Transportation

  - Pipeline

Pipelines to Montesa Park, Pajarito, and Rio Puerco are likely to encounter shallow excavation during construction. The Bluepoint, Kokan, and Madurez soil series, which are among areas to be crossed by proposed pipeline routes are the main soils displaying this limiting characteristic. Wind and water erosion control measures may be necessary during construction of the pipeline (and the associated Montesa Park treatment facilities).

Another prime concern of pipeline transport is the effect upon soils in the event of pipeline leakage or breakage. Soil contamination would likely occur in and near a break. This could adversely affect soil productivity due to overloading of nutrients and toxic elements, depending on the extent of the leakage and the location of the accident. Problems should be short-term, improving naturally once the pipeline damage is repaired.

  - Trucking

Trucking is a transportation option for delivery of sludge to Montesa Park, Pajarito, Rio Puerco, and the landfill. This method of transport should pose little enviornmental difficulty. In case of an accident involving spillage of sludge during transport, some local contamination of soil along the transport route could occur. This should only cause short-term problems involving leaching. The extent of the problem of any spillage would depend on the current use of the soil at the location of the spill.

An evaluation of each action alternative was made with the potential effects discussed in the previous paragraphs in mind. Table 6-2 indicates

Table 6-2. Effects of Optimal Alternatives for the City of Albuquerque Sludge Management Program on Earth Resources.

No.	Effects / Alternatives	Increased Wind Erosion	Increased Water Erosion	Cadmium Increase	Copper Increase	Nitrogen Increase	General Toxic Increase	pH Increase	Chemical Alteration	Productivity Alteration	Permeability Increase	Corrosion Increase	Excavation Problems	Surface Leveling	Accumulation of Toxic Materials
1.	1A			o	o	o	o		o	o					o
2.	1B			o	o	o	o		o	o			●		o
3.	1C			●	●	●	●		●	o					●
4.	1D			●	●	●	●		●	o			●		●
5.	1E			o	o	o	o		o	o					o
6.	1F			o	o	o	o		o	o			●		o
7.	1G			●	●	●	●		●	o					●
8.	1H			●	●	●	●		●	o			●		●
9.	2A	o	o					o							
10.	2B	o	o					o							
11.	3A	●	o	●	●	●	●		●	●	o			o	●
12.	3B	●	o	●	●	●	●		●	●	o	o		o	●
13.	3C	●	o	●	●	●	●		●	●	o	o		o	●
14.	3D	●	o	●	●	●	●		●	●	o			o	●

use
● - significant
o - minor

both major and minor effects on earth resources that will occur due to construction and implementation of each action alternative.

6.2 SURFACE WATER RESOURCES

6.2.1 Existing Conditions

- Hydrology

The Study Area (Bernalillo County) is located in the Middle Rio Grande River Basin of central New Mexico. The basin has an area of approximately 11,880 sq mi and a total length of approximately 228 mi. Drainage area upstream of the City of Albuquerque measures approximately 14,500 sq mi and produces an average annual discharge of 779,600 ac ft or approximately 1.01 inches runoff per year. The main direction of flow through the basin is south southwest. Major tributaries of the Rio Grande in Bernalillo County include Arroyo de las Calabacillas, Arroyo de Domingo Baca, Arroyo del Pino, Arroyo del Embudo, Tijeras Arroyo, and Bear Arroyo.

Flows in the Rio Grande River measured at Albuquerque vary substantially. During the period of 1974 to 1979 the average discharge was 1,076 cubic feet per second (cfs) (USGS 1980). Historically, the flow has been as high as 25,000 cfs and as low as 0 cfs. Ninety percent of the time, the flow is equal to or greater than 37 cfs at Albuquerque. Currently, the Rio Grande near Albuquerque is classified as water quality limited and designated water uses include irrigation, limited warmwater fishery, livestock and wildlife watering, and secondary contact recreation (NM WQCC 1980).

Spring flows (April-June) which result from snow-melt and precipitation are characterized by gradual stage rises, moderate discharge levels, large volumes of flow, and long durations. Summer and flash flood flows (May-October) generally peak quickly at high discharge levels and contain smaller volumes of runoff. Due to the construction of levees, dikes, and jetties and increased channelization to decrease the potential for flooding, the main channel of the Rio Grande has been so extensively modified within the Middle Rio Grande Basin that in several locations, the entire flow of the river is carried in conveyance channels rather than the main channel proper (NM WQCC 1976).

The Tijeras Arroyo, much like the Rio Grande, carries a widely fluctuating flow. After rainfall, flow in the arroyo can become very high (up to approximately 2,500 cfs); however, there are also extended periods of no flow. The Tijeras Arroyo has a drainage area of 133 sq mi.

Basically, the surface water hydrology characteristics of the Middle Rio Grande Basin remain essentially unchanged from those described in the 1977 EIS.

- Surface Water Quality

Data to evaluate surface water quality of the Rio Grande and tributaries near Bernalillo County are inadequate to form all but the most general conclusions. Most available data from recent sources (USGS, NMEID, City of Albuquerque, and Patterson 1970) have been tabulated and presented in the 1977 EIS. Additionally, the 1977 EIS document contains a detailed discussion of surface water quality in the basin, extensive references to the literature, evaluation of all major physical, chemical and biological parameters and the effects of wastewater management in Albuquerque.

Among the most severe surface water quality problems in the Study Area are high levels of suspended solids, dissolved solids, and fecal coliform bacteria. Additionally, manganese and iron are present at high, undesirable concentrations and there is concern that lead, cadmium, chromium, copper, mercury, molybdenum and zinc may be present in elevated amounts (Table 5-2).

Nutrients in the Rio Grande River immediately below the City of Albuquerque and its sewage treatment plants increase substantially from upstream levels. Ammonia nitrogen, Kjeldahl-nitrogen, nitrate-nitrogen, ortho-phosphate, and total phosphorus exhibit a tripling in concentrations (flow weighted) between Bridge Avenue in Albuquerque and Isleta Dam, approximately 12 miles downstream. Further downstream, however, all nutrients except nitrate-nitrogen show decreased concentrations.

Chemical surface water quality data from any tributary of the Rio Grande near Bernalillo County is scarce. One monitoring station on Tijeras Arroyo near Albuquerque operated by USGS does collect chemical data but its short period of record (August 1979 to present) and extended periods of no flow have produced little definitive data.

In general, surface water in the Study Area tends to be warm, have high pH, moderately hard and alkaline, and the quality has changed little since the 1977 EIS.

- Floodplains

Areas of potential flooding are present throughout the Study Area Most flooding results from overflowing of the Rio Grande during either spring or early summer, or from flash floods from local arroyos in response to intense, localized summer thunderstorms (EPA 1977).

The National Flood Insurance Program (NFIP) has prepared flood hazard boundary maps (FHBM) for the entirety of Bernalillo County. These maps indicate that areas most prone to flooding are located mainly along low lying areas near the Rio Grande, Tijeras Arroyo, conveyance channels, canals, drains, and other large arroyos. The FHBM illustrate that the construction area inside Montesa Park contains no flood prone areas; however, the northern and western portions of the proposed Rio Puerco dedicated land disposal site and the extreme southern portion of the proposed Pajarito site do contain areas prone to flooding.

Currently, floodplain information is being revised throughout the Study Area. The NFIP is performing a study (Type 15) to delineate all 100 and 500 year floodplains in Bernalillo County. This program is on-going and should be completed by autumn or early winter 1981 (Stier 1981).

- **Water Rights**

The ground and surface waters of New Mexico are public property and are subject to appropriation by State law. The legal rights to these waters are determined by regulations of the New Mexico State Engineer, whose policies are designed to protect and stabilize flows in the Rio Grande. A complete discussion of New Mexico's water rights administration is available in Reynolds et al. (1976).

6.2.2 Environmental Consequences of the No Action Alternative

The effects of the City taking no-action will result in degradation of surface water quality in the Rio Grande River at and below Albuquerque. Current estimates are that Plant No. 2 potentially will be required to operate at 13 mgd beyond design characteristics. This overload will raise not only discharge, but total suspended solids (TSS) and biochemical oxygen demand (BOD) of the effluent. Due to the addition of the inadequately treated surface runoff from open sludge lagoons into the river, it is probable that dissolved oxygen concentrations will be lowered while turbidity, nutrients, toxic elements, and pathogenic bacteria will increase in concentration.

An additional adverse effect on water quality will result from long-term continued sludge stockpiling at Montesa Park. Stormwater runoff from the stockpile potentially may contain considerable amounts of BOD, TSS, and soluble toxic elements that eventually could flow into the Tijeras Arroyo and Rio Grande River.

6.2.3 Environmental Consequences of the Action Alternatives

The following sections will describe the effects upon hydrology, water quality, flood plains, and water rights for all proposed action alternatives. These alternatives are composed of various sludge treatment and disposal methods (discussed in Chapter 5) and have the common goal of successfully and permanently removing organic and inorganic solids (sludge) from the sewage and discharging an effluent of acceptable quality.

Potential environmental consequences due to implementation of the various treatment options and/or components are presented in Table 6-3. An evaluation was made of the 14 action alternatives with respect to the components involved and the cumulative effects of components in each alternative. Table 6-4 lists the major and minor effects that will occur regarding surface water quality within the study area. These effects are discussed in the following paragraphs.

- Hydrology

All action alternatives will have a similar effect on surface water hydrology. Sewage effluent discharged from Plant No. 2 will increase from a current average of 34.3 mgd (Bruce 1981) to approximately 60 mgd. This increase will be taken mainly from groundwater reserves rather than from upstream surface water sources. The result will be that the base flow of the Rio Grande River will increase approximately 39.8 cfs (28,785 ac ft/yr) below the outfall of Plant No. 2. Additionally, runoff control (if implemented) from the dedicated land disposal sites would remove runoff from approximately 3580 ac from the drainage area of the Middle Rio Grande Basin resulting in a net decrease in yield of approximately 300 ac ft/yr.

- Surface Water Quality

As presented in Table 6-4, potential effects to surface water quality will vary in type and magnitude depending upon which action alternative is chosen. Degradation of surface water quality due to the project should be minimal as long as surface water runoff is controlled at each sludge processing or disposal site.

Potential decreases in dissolved oxygen concentrations may occur in area waters receiving runoff from landspread areas in city parks, golf courses, or dedicated land disposal sites. Alternatives which have this potential are alternatives 1A through 1H, and Alternatives 3A through 3D.

Table 6-3. Potential effects of options upon water quality or quantity.

Option	Effect
Dissolved Air Flotation	• no effect if properly maintained
Anaerobic Digestion	• no effect if properly maintained
Organic Polymer	• no effect
Lime/Ferric Chloride	• no effect
Truck Transportation of Sludge	• if new roads are constructed, increased sediment load and turbidity can result from land disturbance. • Runoff can increase if impervious surfaces are required.
Pipeline Transportation of Sludge	• During construction increased sediment load and turbidity can result from land disturbance. • Potential overflows of sludge wetwells can increase nutrients in surface runoff.
Belt Press	• no effect if properly maintained
Filter Press	• no effect if properly maintained
Solar Greenhouse Sludge Drying	• no effect
Open Air Sludge Drying	• no effect
Cesium-137 Sludge Irradiation	• no effect
Electron Beam Sludge Irradiation	• no effect
Composting of Sludge	• Potential increases in nutrients, sediment loading, toxic elements, and pathogens in surface runoff to area rivers, and streams • Effects easily mitigated by controlling runoff
Landfilling of Sludge	• no effect
Landspreading Sludge on City Parks and Golf Courses	• increased nutrients and toxic elements in surface runoff, area rivers and streams.
Dedicated Land Disposal of Sludge	• same as for composting, except potential for large scale pollution is very high if surface runoff is not controlled

Table 6-4. Effects of Optimal Alternatives for the City of Albuquerque Sludge Management Program on Water Resources.

No.	Effects Alternatives	Decrease in Dissolved O_2	Increase in Turbidity	Potential Increased (NH_3) NO_2 & NO_3	Potential Increased PO_4	Potential Increased Pathogens	Potential Increased Toxic Elements	Increased Water Quantity	Alterations to Drainage Area Characteristics
1.	1A	o		o	o		●	o	
2.	1B	o	o	o	o		●	o	
3.	1C	o		o	o		●	o	
4.	1D	o	o	o	o		●	o	
5.	1E	o		o	o		●	o	
6.	1F	o	o	o	o		●	o	
7.	1G	o		o	o		●	o	
8.	1H	o	o	o	o		●	o	
9.	2A							o	
10.	2B							o	
11.	3A	o	o	o	o	●	●	o	o
12.	3B	o	o	o	o	●	●	o	o
13.	3C	o	o	o	o	●	●	o	o
14.	3D	o	o	o	o	●	●	o	o

Use - o minor effect
● major effect

Short-term increases in turbidity will result from pipeline construction. This will result mainly from precipitation falling on unvegetated disturbed areas created during pipeline emplacement. Relatively short pipelines (Alternatives 1B, 1D, 1F and 1H) will have fewer potential adverse effects than longer pipelines to dedicated land disposal sites (Alternatives 3B and 3C). Additionally, pipelines have the potential to break causing further localized effects.

All alternatives using land-spreading or dedicated land disposal of sludge have the potential for increasing concentrations of nutrients and toxic elements in area waters. These increases will result mainly from precipitation runoff and can be easily mitigated by runoff control.

Action alternatives using dedicated land disposal of non-disinfected sludge (Alternatives 3A through 3D) have the potential of polluting area waters with pathogenic bacteria, viruses and parasites. As before, these organisms would be contained in runoff from the dedicated land disposal sites and could be easily mitigated by runoff control.

- Floodplains

Potential effects to floodplains resulting from any action alternative are few. All alternatives will increase the baseflow of the Rio Grande below Albuquerque and will result in very small changes in flood frequencies and flood prone area boundaries. These changes and the effects produced will be extremely small and very localized.

Alternatives 2A and 2B propose landfilling as a method of sludge disposal. When a site for the landfill has been selected, efforts should be taken to ensure that the landfill is not located in a flood prone area; or, if it is, that adequate protection against flooding is provided.

Alternatives 3A, 3B, 3C, and 3D propose dedicated land disposal sites that are partially within flood prone areas. Sufficient raising or diking of these areas should be performed before these lands are used for sludge disposal. All other alternatives or options have negligible effects on floodplains or flood prone areas.

- **Water Rights**

New Mexico's water rights allocations near Albuquerque will be indirectly affected by all action alternatives. Each alternative assumes increased population, industrialization, water demand, and water use. These increases are dependent on current appropriations and if increases are sufficient, acquisition of new or abandoned allocations will be necessary.

Currently, the City receives credit for 50% of all groundwater pumped (assumed to be return flow). As demand and discharge increase this credit will increase also.

6.3 GROUNDWATER RESOURCES

6.3.1 Existing Conditions

All of the alternative sites share some common groundwater characteristics as well as some differences. A major similarity of all sites is that they have the same general means of recharge discussed previously for the Project Area. All sites have a southwesterly flow, except for the Rio Puerco and Pajarito sites, which are located on the west side of the "trough," and thus have a southeasterly flow. Differences occur in depth to the water table, hydraulic gradient, quality, and uses of water as discussed below.

Approximate depths to water at each site are as follows: Plant No. 2, less than 10 feet; Montesa Park, 210 feet; Pajarito, 470 feet; and Rio Puerco, 800 feet. Possible landfill sites vary in their depth to water, though the general region being considered has an average depth of approximately 100 feet. The gradient is steepest underneath the Rio Puerco site, though it is less than 1%. It is much less than 1% at all other sites.

Though available information concerning quality is somewhat dated, indications are that quality is good for use as potable water except for a high nitrate area near the Mountainview community at the lower end of Tijeras Arroyo, just south of Plant No. 2. This area has many wells which produce water that exceeds 10 mg/l in nitrates.

Very little groundwater is used at or near the Rio Puerco and Pajarito DLD sites, due to lack of population and comparatively excessive depth to water. Similarly, there is little use of groundwater near Montesa Park or several miles south. Industrial uses dominate around Plant No. 2, while industrial and irrigation uses occur in the potential landfill locations. The major municipal public supply wells are in the central Albuquerque area, several miles south of the potential landfill locations.

6.3.2 Environmental Consequences of the No Action Alternative

If no action is taken to construct and operate any of the optimal action alternatives, some groundwater contamination, especially in the area around Plant No. 2, is very likely. The main environmental concern regarding groundwater is potential contamination by leachate from sludge lagoons and stockpiles. The concern is greatest in shallow water level areas since these are areas where leachate has very little vertical travel to filter contaminants out through the soil. Therefore, the water level depth is directly related to the potential for groundwater contamination by leachate. The most vulnerable area is the inner valley where the water table normally lies within 20 feet of the surface and often times within five feet (USEPA 1977). The drying beds and lagoonal areas at Plant No. 2 would lie within this vulnerable region and thus potentially would create pollution problems if this alternative was implemented.

6.3.3 Environmental Consequences of the Action Alternatives

Of the components (thickening, stabilization, conditioning, etc.) involved in the alternative sludge treatment and disposal processes, drying, transportation, and disposal are the components that potentially could effect groundwater. Different options available under each component will have varying effects.

If proper construction and operational procedures pertaining to each alternative are followed, adverse effects to groundwater should be minimal. Conversely, poor monitoring of operational procedures could have adverse effects upon groundwater quality. The potentially significant effects of each option are discussed below.

- Drying

  - Open Air Drying

The option of open air drying involves sludge accumulations placed upon paved areas; however, runoff and leachates may come in contact with the surface of the earth. The groundwater level underneath Montesa Park is considered to be deep enough to purify leachate prior to its reaching the water table. However, if there are no controlling structures, surface runoff may proceed down Tijeras Arroyo into areas where groundwater is shallow enough to be potentially contaminated by vertical seepage of leachate. This potentially could add to the already present problem of high nitrate levels in groundwater at the lower end of the canyon, thereby limiting use of groundwater in the Mountainview Community and surrounding areas.

- Transportation

  - Pipeline

The proposed pipelines from Plant No. 2 to Montesa Park, Pajarito, or Rio Puerco deserve attention due to the potential for a pipeline rupture resulting in leakage of sludge. This could cause serious nitrate problems in shallow water table locations for users with nearby groundwater wells or wells within several miles of the spill area. Since the flow gradient is in a generally southwesterly direction, wells near and to the south and southwest of a pipeline spill would be the most vulnerable to nitrates and possibly toxic metal contamination. This expecially applies to pipeline locations in the inner valley where groundwater is shallowest.

- **Truck**

No problem is anticipated from trucking of sludge to Montesa Park, the landfill, or either DLD site except in the case of a spillage accident. This could cause some local groundwater contamination in shallow groundwater areas, though such small volumes of sludge as could be spilled from a haul truck would result in only minor, short-term impacts.

- **Disposal**

  - Landspreading

Landspreading of sludge treated at Montesa Park would be applied to City parks and golf courses within the City of Albuquerque to act as a fertilizer and soil conditioner. If spreading application rates are closely regulated, groundwater in most cases should not be affected. However, any parks located in inner valley areas where the water table is within a few feet of the surface should be considered potentially vulnerable to local groundwater contamination, especially if safe application procedures are not carefully followed. Contaminated leachate from sludge spread onto parks will percolate vertically through the generally porous soil and strata in the area. This will then be intercepted by groundwater in locations where the vertical distance is not enough to filter out toxic elements.

A positive condition in the area is the relatively high cation exchange capacity (CEC) of the soils in the project area. Soils of the area are effective in incorporating toxic metals from leachate into their molecular structure. This aids greatly in reducing toxic contents of leachate as it percolates vertically.

A major concern in the Albuquerque area is the occurrence of nitrates in groundwater in some areas. This demands the utmost care in assuring that nitrate causing nitrogen is not overloaded in any landspreading procedure, as there is little to prevent nitrate formation in areas with a shallow water table.

- Landfill

Groundwater would not be substantially adversely affected by sludge disposal in a properly constructed landfill with adequate clay lining. Heavy metals are strongly attenuated by a clay lining (National Academy of Sciences 1977). Pathogens and water soluble organics are little attenuated by clay. However, since the water level below the proposed landfill zone is close to 100 feet below the surface, leachate (if any) from the landfill should be filtered free of contamination by the time it reaches groundwater.

The presence of a clay lining (if utilized) will impede normal groundwater recharge in the particular area covered by the landfill. This is an effect of the landfill construction and will occur regardless of the sludge disposal. The effect will be very minimal considering the relatively small area the landfill covers in comparison to the extensive and porous land area in the project area receiving groundwater recharge from the surface.

- Dedicated Land Disposal at Pajarito and Rio Puerco

The alternatives of using land set aside solely for sludge disposal is feasible from a groundwater perspective provided proper sludge application procedures are followed. The operating technique is to balance sludge loadings such that net soil evaporation equals the total moisture applied in the sludge, therefore theoretically there will be no movement of the sludge constituents from the surface soil horizon (CDM 1980b).

A difficulty in Albuquerque is the predominantly porous nature of soils and sediments. However, since both proposed DLD sites are in areas where the water table is several hundred feet below the surface -- the Pajarito site probably having water over 300 feet deep and the Rio Puerco site over 600 feet deep, the risk of groundwater contamination is lessened in the short-term. However, over a period of years, sludge constituents will accumulate, with leachate carrying contaminants further below the surface as the CEC of the soil is used to full capacity. Therefore, use of either of the two sites may be limited to a certain number of years. It is hard to determine the exact life expectany of a DLD site due to numerous variables and lack of applicable data, but, roughly, a minimum of 20 to 30 years of sludge disposal use is estimated.

Table 6-5 summarizes the major and minor effects upon groundwater that potentially will occur due to the action alternatives.

6.4 AIR AND SOUND QUALITY

6.4.1 Existing Conditions

- Climate

The basic climatic information for Albuquerque is as follows: average temperature is 55.8° F; average annual rainfall is 7.8 inches; average annual relative humidity varies from 31% at 5:00 p.m. to 64% at 5:00 a.m.; and average wind speed is 9 miles per hour. Wind direction in Albuquerque is illustrated in Figure 6-3. A predominate feature of the climate of Albuquerque is the large number of clear days and the high percentage of sunshine.

- Ambient Air Quality

Albuquerque is part of Federal Air Quality Control Region 152 and part of New Mexico's Air Quality Control Region 2. Modifications to wastewater treatment Plant No. 2 and remote sludge management facilities must be compatible with National Ambient Air Quality Standards (NAAQS) and New Mexico's Ambient Air Quality Standards. Table 6-6 presents the NAAQS and the New Mexico Ambient Air Quality standards.

An area that does not meet the NAAQS for a particular pollutant is classified as nonattainment for that pollutant. All of Bernalillo County is nonattainment for carbon monoxide (CO) and parts of Albuquerque are nonattainment for total suspended particulates (TSP) and photochemical oxidants. Nonattainment areas of the City are shown in Figure 6-4. Automo-

Table 6-5. Effects of Optimal Alternatives for the City of Albuquerque Sludge Management Program on Groundwater Resources.

No.	Effects Alternatives	Nitrate Increase	General Toxic Increase	Recharge	Use Limitations	Potential Long-Term Contamination	Contamination by Accident	Pathogenic Contamination
1.	1A	o	o	X	o	o	●	o
2.	1B	o	o	X	o	o	●	o
3.	1C	o	o	X	o	o	●	o
4.	1D	o	o	X	o	o	●	o
5.	1E	o	o	X	o	o	●	o
6.	1F	o	o	X	o	o	●	o
7.	1G	o	o	X	o	o	●	o
8.	1H	o	o	X	o	o	●	o
9.	2A	o		o			●	o
10.	2B	o	o	o			●	o
11.	3A	o	o			o	●	o
12.	3B	o	o			o	●	o
13.	3C	o	o			o	●	o
14.	3D	o	o			o	●	o
use								

● - significant

o - minor

X - beneficial potential

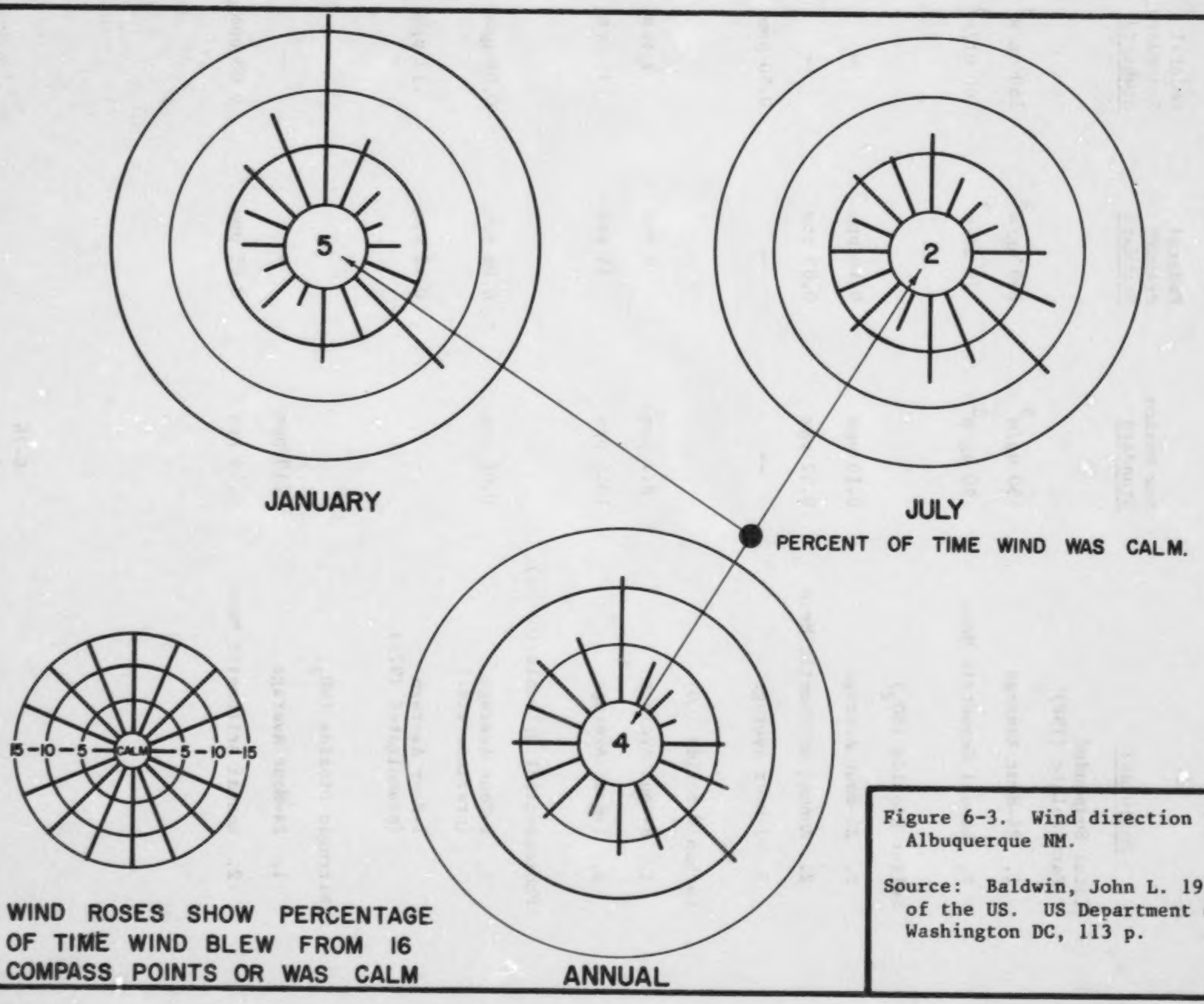

Figure 6-3. Wind direction in Albuquerque NM.

Source: Baldwin, John L. 1973. Climates of the US. US Department of Commerce. Washington DC, 113 p.

Table 6-6. State and Federal ambient air quality standards.

Pollutant	New Mexico Standard	Federal Primary Standard	Federal Secondary Standard
Total Suspended Particulate (TSP)			
1. 24-Hour Average	150 ug/m^3	260 ug/m^3	150 ug/m^3
2. Annual Geometric Mean	60 ug/m^3	75 ut/m^3	60 ut/m^3
Sulfur Dioxide (SO_2)			
1. 24-Hour Average	0.10 ppm	0.14 ppm	—
2. Annual Arithmetic Mean	0.02 ppm	0.03 ppm	—
3. 3-Hour Average	--	--	0.50 ppm
Carbon Monoxide (CO)			
1. 8-Hour Average	8.7 ppm	9 ppm	9 ppm
2. 1-Hour Average	13.1 ppm	35 ppm	35 ppm
Photochemical Oxidants (Ozone)			
1. 1-Hour Average (previous std.)	0.06 ppm	0.08 ppm	0.08 ppm
1-Hour Average (promulgated 1979)	—	0.12 ppm	.12 ppm
Nitrogen Dioxide (NO_2)			
1. 24-Hour Average	0.10 ppm	—	--
2. Annual Arithmetic Mean	0.05 ppm	0.05 ppm	0.05 ppm

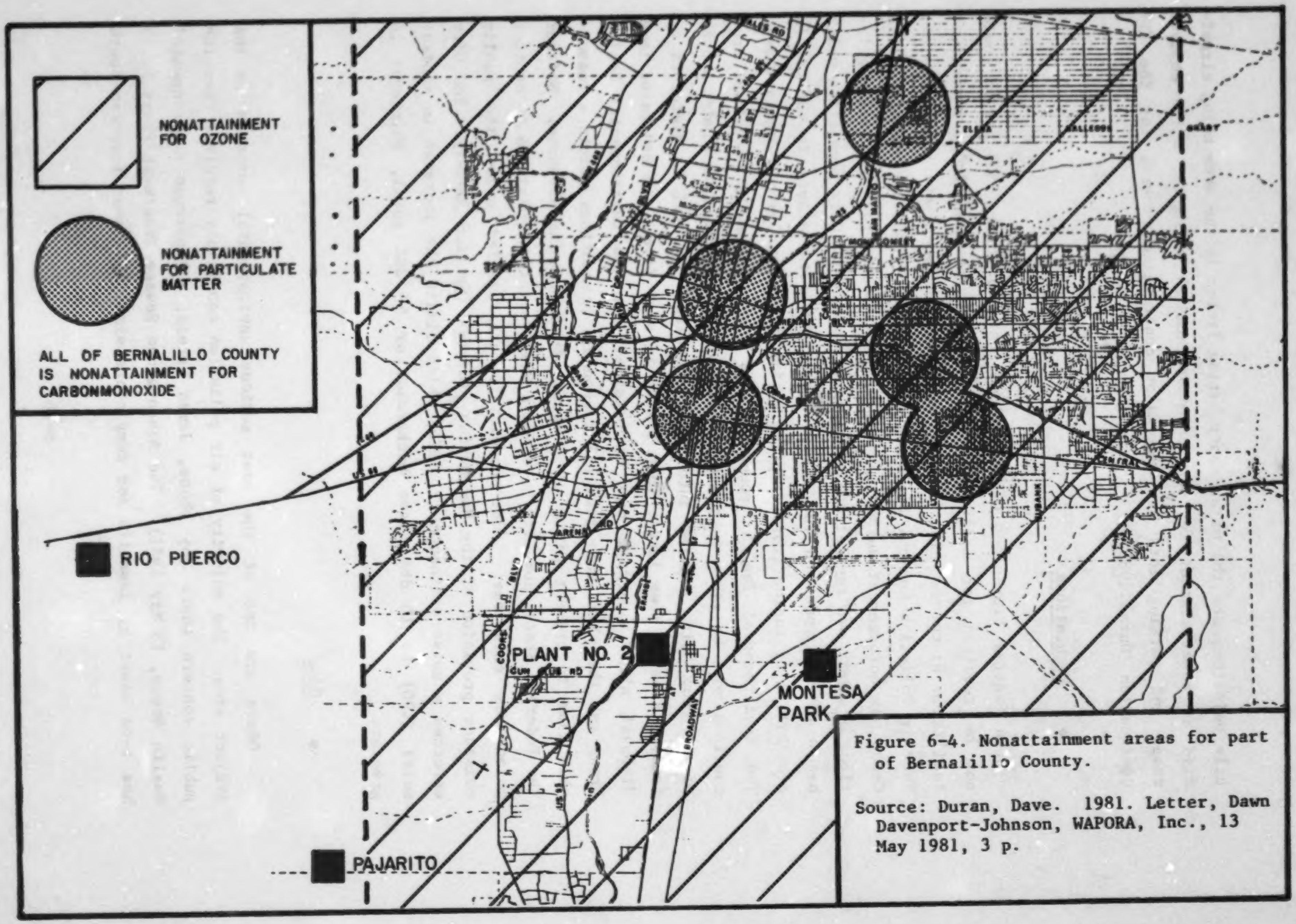
NONATTAINMENT FOR OZONE
NONATTAINMENT FOR PARTICULATE MATTER
ALL OF BERNALILLO COUNTY IS NONATTAINMENT FOR CARBONMONOXIDE
RIO PUERCO
PLANT NO. 2
MONTESA PARK
PAJARITO
COORS
GUN CLUB RD
BROADWAY
MONTGOMERY
SAN MATEO
CENTRAL
GIBSON
ARENAL RD

Figure 6-4. Nonattainment areas for part of Bernalillo County.

Source: Duran, Dave. 1981. Letter, Dawn Davenport-Johnson, WAPORA, Inc., 13 May 1981, 3 p.

bile emissions are the major contributing factor in the area being classified as nonattainment for CO and photochemical oxidants, while unpaved roads and parking lots are the major contributing source for the TSP designation (Duran 1981).

- Regulations

A Federal Prevention of Significant Deterioration (PSD) permit would not be required for modifications to the Albuquerque sludge management facilities since the plant is not considered a major stationary source. The Air Pollution Control Division of the Albuquerque Environmental Health Group has enforcement authority in Bernalillo County for the state regulations or their own regulations where applicable. One City regulation which has a direct impact on the sludge management alternatives is the City's prohibition of incinerators (Section 4, Air Pollution Control Regulations). The Environmental Health Group requires that reasonable effective precautions must be taken to prevent fugitive dust (i.e., from sludge stockpiles) from being emitted into the atmosphere. If soil is disturbed or removed from an area larger than 3/4 ac in size (i.e., the dedicated land disposal site) a permit must be obtained from the Environmental Health Group and the plant must take all reasonable precautions within a reasonable time to prevent particulate matter from becoming airborne. Neither the Federal, State, nor City government has specific regulations to control malodorous emissions. Odor complaints are handled under the public nuisance provision of the New Mexico Statutes (Section 30-8-1). The City enforces a noise ordinance (21-1975) which limits the increase in ambient noise (L90) to 10 dBA above background or 50 dBA total, whichever is greater.

- Odor

Odors are one of the most serious environmental concerns in the project area. The majority of air pollution complaints received from the public concern odors (by phone, James Lareau, Albuquerque Environmental Health Group, 13 May 1981). The Albuquerque Sewage Treatment Plant No. 2 has been beset by lawsuits and complaints since 1964 when fourteen South

Valley residents brought suit against the City to obtain compensation for odor damages from Plant No. 2. In 1966, it was ruled that compensation was proper, and the "odor rights" of the individuals were purchased by the City. In 1973 odor was a major cause for the lawsuit and stipulation (Mt. View et al. vs. Fri et al.) which set forth as the basic goal of odor control the use of "Best Practicable Control Technology". In 1976, the plant suffered a severe odorous upset, resulting in a petition of protest signed by more than 120 persons. In 1980 there was another stipulation which in part required the City to institute the following conditions at Plant No. 1: (1) not vent odorous gases, (2) discontinue the use of sludge drying beds, (3) remove sludge on a daily basis, and (4) renovate the sludge digesters.

Regional odor problems are concentrated along the valley -- especially the South Valley -- and result from two major sources: wastewater treatment plants and animal confinement/meat processing facilities. Although some observers can distinguish between the two sources, the odors are somewhat similar and often occur together. Thus, it is difficult to evaluate the separate significance of the two sources. However, it is certain that treatment plant odors have had a significant long-term impact on immediate neighborhoods and areas downwind (USEPA 1977a). It was determined in the 1977 EIS for the Albuquerque Wastewater Treatment Facilities that the most serious problems occur from May to August, especially in June and July. Winds vary during this period, exposing persons in all directions to odors. The Mountainview community is especially impacted because of the year-round occurrence of winds from the north-northwest. However, impacts over an area of many square miles have been reported. The odors tend to be worse, or reportedly most noticed, in the evening (USEPA 1977a).

- **Noise**

Ambient noise levels were tested for Montesa Park and Plant No. 2 in July of 1981 by the Albuquerque Health Department. The primary noise at Montesa Park was generated by jet and propeller aircraft. The Albuquerque police pistol range is located at Montesa Park but did not have a significant effect on the ambient noise level. The ambient L90 noise level is 35 dBA. For comparison, the typical residential area within the city is between 48 to 52 dBA.

Plant No. 2 is situated in a rural-residential area. Ambient L90 noise levels are 51 dBA at the eastern edge of the plant near the entrance, 57 dBA at the western boundary, and 58 dBA in the center of the plant (Orton 1981).

The Rio Puerco dedicated land disposal site is located on the West Mesa and is influenced by background city noise and a flight pathway for the Albuquerque National Airport. When not influenced by airplanes the ambient L90 noise level is approixmately 35 dBA. Airplanes raise the ambient noise level to approximately 65 dBA (by phone, Miles Orton, Albuquerque Department of Health, 9 July 1981).

The Pajarito dedicated land disposal site is located on the western slope of the West Mesa and therefore is not influenced by background city noise. The ambient L90 noise level (when wind is less than 12 mph) is approximately 35 dBA (by phone, Miles Orton, Albuquerque Department of Health, 9 July 1981).

6.4.2 Environmental Consequences of the No Action Alternative

With the no action alternative, the treatment Plant No. 2 would be overloaded by 13 MGD and the existing drying beds would be utilized to capacity which would cause substantial odor, fugitive dust, and a potential for pathogenic aerosols. Sludge from the drying beds would be stockpiled indefinitely at Montesa Park. A stockpile of this potential size would be a major source of odors and would also produce fugitive dust emissions unless it was protected from wind. Any excess sludge would be lagooned north of the plant, resulting in substantial increases in odors and the potential for pathogenic aerosols in areas near Plant No. 2.

6.4.3 Environmental Consequences of the Action Alternatives

Effects from major sludge treatment and disposal options (i.e., anaerobic digesters, stockpiles, etc.) which potentially will occur are presented in Table 6-7 and Table 6-8. Criteria pollutants such as sulfur dioxide, carbon monoxide, and nitrogen dioxide are not emitted in substantial quantities. Major effects from the sludge management alternatives on air and noise resources are odor, pathogenic aerosols, and the potential for radiation exposure. These effects will be discussed further.

An evaluation was made of the 14 action alternatives using the information in Table 6-7. Effects that will occur due to implementation of the action alternatives are listed in Table 6-9. Implementation of any action alternative will result in secondary impacts to air quality caused by induced growth. Increasing the capacity of the sewage treatment facility allows further growth in the Albuquerque area. With this growth comes some degradation of air quality caused by increased vehicular emissions, increase particulate matter from burning of wood in residential fireplaces, and increased emissions from new industry.

- Odor

If sludge is properly digested, the odors associated with sludge management alternatives would be considered minor. The following options are potential sources of significant odor, if sludge is not properly digested: solar greenhouse, open air drying, certain stages of composting, dedicated land disposal (DLD), and sludge stockpiles. For more detailed information on these options see Table 6-7. There also are other significant sources of odors at Plant No. 2 that do not involve the sludge management system (i.e., headworks, primary clarifiers, etc.). Locations in wastewater systems where odors may develop are presented in Table 6-10. Malodorous emissions tend to be worse in warmer weather and in sludge with a higher moisture content.

Table 6-7. Potential air effects associated with sludge management options.

DAF

- minor odor associated with exhaust gas unless treated

Anaerobic Digestion

- minor odor potential if digesters are functioning properly
- reduces pathogens in the sludge

Organic Polymer Conditioning

- Could increase bacterial production of odorous substances

Lime/Ferric Chloride Conditioning

- lime produces better stabilized sludge having less odor
- reduces pathogens in the sludge highly effective at pH 11.5

Belt Press

- minor odor potential; more of an odor problem than filter press because sludge is exposed to the atmosphere longer

Filter Press

- minor odor potential; less of an odor problem than belt press due to the short time that sludge would be exposed to the atmosphere

Greenhouse

- significant odor associated with exhaust gas if sludge is not properly digested unless an odor control device (e.g., scrubber) is used
- potential for dust and pathogenic aerosols

Open Air Drying

- significant odor, if sludge is not properly digested
- potential for dust and pathogenic aerosols; this potential will be reduced by the proposed walls surrounding the drying area

Table 6-7. Potential air effects associated with sludge management options (continued).

Cesium-137 Irradiator

- small potential for overexposure to radiation of occupational personnel and the public due to abnormal events (accidents); for more information see Appendix 10.2
- during normal operation, the irradiator will be designed so that there will be no discernible radiation exposure outside the facility
- during normal operation of the pilot irradiation facility at Sandia Laboratories there has been no dose rate over 0.05 rems per year to workers inside the irradiator facility
- since irradiated sludge has a higher content of biodegradable organic matter than composted sludge, it would be more likely to produce an odor problem. However, since Albuquerque has been land applying sand-bed-dried, anaerobically-digested sludge for years, this probably is not a problem (Kowal 1981)

Electron Beam Irradiator

- extremely small potential for radiation exposure of occupational personnel and the public since interlocking safety system would shut the system off in case of accidents; when the system is off there is no production of radiation; for more information see Appendix 10.3
- the facility will be designed so that there will be no discernible radiation exposure outside the facility
- during normal operation of a pilot irradiator there has been no measurable radiation exposure to the workers inside the facility

Composting

- significant odor could be generated from the sludge before it is covered with an insulating layer if the sludge is not properly digested; minor odor present after insulating layer is applied; odor associated with the air drawn through the pile is greatly reduced by being released into a small pile of screened compost which absorbs the malodorous gases
- pathogenic aerosols could be released during the stacking of the sludge before the insulation layer is placed on the pile
- high concentration of Aspergillus fumigatus (fungi that pose a pathogenic threat to man); generally restricted to the immediate composting area and should not pose a significant health threat to surrounding area

Table 6-7. Potential air effects associated with sludge management options (continued).

Landspread on Public Lands

- minor odor from the sludge - dependent on: (1) whether it has been thoroughly digested; (2) time of year (summer is worse); and (3) moisture content (odor is worse if precipitation follows application) - the Parks and Recreation Department has had very few complaints (by phone, Al Boberg, Parks and Recreation Department, 29 June 1981)
- very little dust associated with the sludge application due primarily to the method of application (scoop shovels) which keep the sludge close to the ground

Landfill

- odor problems exist at landfills regardless of whether sludge is present; sludge will make up a very small percentage of the material disposed of in the landfill
- dust is a problem at landfills regardless of whether sludge is present
- potentially explosive gases are present at a landfill site regardless of whether sludge is present

Dedicated Land Disposal

- significant odor from sludge if it has not been thoroughly digested
- potential for substantial dust as the sludge dries, and due to on-site removal of vegetation
- potential for pathogenic aerosols

Truck Transportation

- minimal increased emissions along route - the impact will be greatest when these routes traverse residential areas
- odor is associated with transportation of wet sludge by truck; these odors will impact areas along the route
- significant increased dust could occur where routes follow dirt roads (i.e., the proposed truck route to the Rio Puerco DLD site) if there is no dust control

Table 6-7. Potential air effects associated with sludge management options (concluded).

Pipeline Transportation

- increased dust during construction - short-term

Stockpiling of Sludge

- there is a maximum of three stockpiles and a minimum of zero stockpiles associated with the alternatives
- significant odor is associated with all stockpiles if the sludge is not properly digested regardless of the percent solid, although the odor lessens as the sludge dries (i.e., the 20% solid stockpile will have a greater odor than the 40-90% stockpile)
- the size of the 20% and 40% sludge stockpiles (for group 1 alternatives) will be considerably smaller than the 40-90% final stockpile
- dust associated with sludge as it dries to approximately 40% solid; a wall around the stockpile will greatly reduce the dust; it is proposed that only one smaller stockpile will have a wall surrounding it
- when sludge is stockpiled before it is disinfected there is a potential for dust and pathogenic aerosols

Table 6-8. Potential noise effects associated with sludge management options.

Dissolved Air Flotation (DAF)

- generates a substantial amount of noise unless shielded
- the ambient noise level 25 feet from a building containing a DAF unit would be approximately 65 dBA

Dedicated Land Disposal

- increase noise in area of land disposal due to dump trucks, tank trucks, and tractors
- this noise would be continuous throughout the year

Landspread on Public Lands

- noise associated with the landspreading of sludge due to the trucks used to transport the sludge and the spreading equipment
- this noise would not be continuous throughout the year
- there is noise associated with the spreading of any fertilizer

Landfill

- noise is associated with the landfilling of sludge, but the landfill site will exist with or without being used for sludge disposal; therefore there will be an increase in noise in the surrounding area even if the sludge is not disposed of in the landfill

Truck Transportation of Sludge

- when the truck routes follow high volume roads the existing noise level would be increased by less than 2 dBA and is therefore insignificant (USDOT 1973)
- the increase in noise levels would be greater on roads with less traffic

Pipeline Transportation of Sludge

- short-term noise impact during construction - the effect will be greatest when the pipeline traverses residential areas or is built close to other noise sensitive receptors (i.e., schools)

Table 6-9. Effects of Optimal Alternatives for the City of Albuquerque Sludge Management Program on Air Resources.

No.	Effects Alternatives	Odor	Potential Overexposure to Radiation	Aerosols Containing Pathogens	Fugitive Dust Emissions	Increase in Vehicle Emissions	Short-Term Dust & Noise from Pipeline Construction
1.	1A	●	o	o	o	o	
2.	1B	●	o	o	o		●
3.	1C	●	o	o	●	o	
4.	1D	●	o	o	●		●
5.	1E	●		o	●	o	
6.	1F	●		o	●		●
7.	1G	●		o	o	o	
8.	1H	●		o	o		●
9.	2A	o		o			
10.	2B	o		o			
11.	3A	●		o	●	o	
12.	3B	●		o	●		●
13.	3C	●		o	●		●
14.	3D	●		o	●	o	

● - major
o - minor

Table 6-10. **Locations in wastewater systems where odors may develop.**

Location	Wastewater	Grit	Screenings	Scum	Sludge	Waste Air	Slime on Walls	Organic Dirt on Surfaces	Sludge Deposits	Dark or Porous Walls	Chemical Spills	Eddy or Short-Circuited Areas
Gravity sewers	x					x	x		x			
Force mains	x					x	x		x			
Pumping stations:												
Wet wells	x			x			x	x	x	x	x	x
Dry wells	x							x		x		
Stilling wells				x			x	x	x	x		x
Grit chamber	x	x		x	x		x	x				
Screens	x		x				x	x	x	x		
Grease, screenings and grit handling		x	x	x	x		x	x				
Equalization tank	x			x	x	x	x	x	x			
Primary settling basin:	x			x	x		x	x	x	x		x
Sludge transfer					x			x	x	x		
Scum transfer	x			x			x	x		x		
Chemical addition						x	x				x	
Aeration tanks	x					x			x			x
Trickling filters	x			x		x	x	x	x	x		x
Ponds	x			x				x	x			
Biodisks						x	x	x		x		
Final settling basins	x			x	x	x	x	x	x	x	x	x
Granular media filters	x						x	x	x	x		
Sludge pumping					x			x	x	x		
Sludge thickening				x	x	x	x	x	x	x		
Sludge storage				x	x	x	x	x	x	x		
Sludge conditioning				x	x	x	x	x	x	x	x	
Sludge dewatering	x			x	x	x	x	x	x	x	x	
Sludge digestion					x	x	x	x	x	x		
Heat treatment					x	x	x	x	x			
Process sidestream handling	x				x		x	x	x			
Septage handling	x				x	x	x	x	x	x	x	
Land irrigation	x					x	x	x	x	x		
Effluent structure	x					x	x	x		x	x	
Ventilation system						x		x	x	x		
Sumps for drainage	x			x	x		x	x		x	x	
Channels for drainage	x			x			x	x	x	x	x	x
Flow distribution structures				x			x	x	x	x		x
Chemical contact tanks						x	x	x	x	x	x	x
Carbon columns							x	x		x	x	
Sludge incineration						x		x				
Sludge composting					x	x	x	x	x	x	x	
Sludge spreading					x							

Source: Task force on Odor Control. 1979. Odor control for wastewater facilities, manual of practice No. 22. Lancaster Press, Inc., Lancaster PA, 80 p.

With Group 1 alternatives (1A-1H) the major sources of malodorous emissions associated with sludge management will be located at Montesa Park. Sludge will not be transported to Montesa Park in the second (2A and 2B) and third (3A-3D) groups of alternatives; therefore, the odors associated with these alternatives will be located at Plant No. 2 and the disposal sites.

The Group 1 alternatives involving disposal by landspreading on city parks include, with the exception of 1E and 1F, either solar greenhouse or open air drying which are both potentially significant sources of odorous emissions. Stockpiles, another cause of odors, would also be a part of the first group of alternatives. Alternatives 1A, 1B, 1C, 1D, 1G and 1H will have three stockpiles. One stockpile will be at 20% solid, one at 40% solid, and one at 40% solid that will eventually dry to approximately 90% solid. The 40-90% stockpile would be the largest due to the longer retention time. Alternative 1E and 1F will have two stockpiles: one at 20% solid, and one at approximately 70% drying to 90% solid.

There will be no drying component (greenhouse or open air drying) included in Group 2 or Group 3 alternatives. There will be one stockpile/storage area with a short retention time included in the Group 2 alternatives. The Group 3 alternatives will have no stockpiles. The dedicated land disposal option which will be included in the third group of alternatives is a significant source of odor. Odors associated with dedicated land disposal will originate from the Rio Puerco or Pajarito site.

Malodorous pollutants related to the sludge handling facilities will either be emitted from a point source (i.e., exhaust gases from the DAF, greenhouse, etc.) or from open sources (i.e., stockpiles, DLD, etc.). These odorants will be transported and diluted by the wind and are greatly influenced by local topography. For instance, the wind and therefore the pollutants are channeled in pronounced valleys such as the Tijeras Arroyo. It should be understood that the intensity of these odors is highly dependent on the proper functioning of the sludge management facility and the atmosphere dispersion that would occur before the odors reached the Mountainview Community.

Atmospheric inversions decrease turbulence and therefore increase surface concentrations of odors (Cheremisinoff 1975, Turk 1974). The time that Albuquerque will experience odors concentrated by inversions will vary from 30% in summer to 48% in winter (Hosler, 1961).

- **Pathogenic Aerosols**

Small droplets of wastewater which could contain pathogens (bacterium or virus) are emitted into the air at wastewater treatment plants. These droplets evaporate very rapidly to yield small droplet nuclei known as aerosols (Rahren 1980). The generation of aerosols is usually associated with such wastewater treatment processes as activated sludge, trickling filtration, and land application by spray irrigation. Although these treatment processes are not a part of any sludge management alternative being evaluated, there also is a small potential for the emission of aerosols when non-disinfected sludge comes into contact with air (i.e., stockpiles, greenhouse, etc.). Lime conditioning and anaerobic digestion reduce the quantity of pathogens that are present in the sludge (Pahren 1980). After emission, pathogenic aerosols are further reduced by aerosol impacts (initial die-off factors such as relative humidity, temperature, and sunlight) and biological decay. All of the alternatives evaluated have some minor potential for generating pathogenic aerosols.

- **Radiation Exposure**

  - Cesium-137 Irradiator

A sewage sludge irradiator is designed to utilize gamma rays from cesium chloride (Cs-137) to disinfect sludge. The irradiator for the Albuquerque sludge management program has not been designed yet, but certain design criteria are known. If this option is chosen for the Albuquerque facility, it will incorporate safety features at least as stringent as those present at the Sandia Irradiator for Dried Sewage Solids (SIDSS) pilot facility located at Sandia National Laboratories. Any improvements that have been learned from work at the SIDSS also will be incorporated (Khera 1981).

The highest penetrating dose rate to personnel working at the irradiation facility is expected to be 0.05 rem per year for a maximum of seven to eight individuals (McMullen 1981). The Federal standard for radiation workers is the equivalent of 5 rem per year (10 CFR part 20.101). For comparison, the natural external radiation background in the Albuquerque area has been measured to be approximately 150 to 200 millirem (0.15 to 0.2 rem) per year per person (ERDA 1977). The dose rate expected outside the facility during operation and decommissioning is expected to be essentially zero. The primary shielding of the cesium chloride gamma ray source will be the massive steel reinforced concrete structure of the facility (McMullen 1981).

The quantity of Cesium-137 contained within the irradiator will be approximately 15 million curies. When dealing with large quantities of radioactive material, there is always the potential of overexposure and/or the release of radioactive material resulting from abnormal events. Most of these abnormal events, usually referred to as accidents, would not result in overexposure to the occupational personnel or the general public from radiation. The most realistic accidents which could be expected are: pool cover drop, transportation cask drop, shielding water release, pool cover removed without water in the pool, problems with the shutter, source pin leak, fire, explosion, security problems, and accidents caused by natural events. A detailed description of these accidents as well as the safety features incorporated in the irradiator to prevent these accidents is presented in Appendix 10.2. This appendix also includes a discussion of the safety record for some of the existing irradiators throughout the US. Although these irradiators are smaller than the proposed Albuquerque irradiator and they usually use Cobalt-60 as the source of gamma rays, the technology is similar to Albuquerque's proposed irradiator and therefore a discussion of their safety record is appropriate.

- Electron Beam Irradiator

The basic concept behind this technology is to use electricity to excite a tungsten filament which emits electrons. The electrons move at 94 percent of the speed of light and are swept back and forth by the electron beam scanner. The electrons lose energy in collisions with atoms and molecules and produce ionization which causes powerful disinfecting and detoxifying effects. The high energy electrons bombarding surfaces produces x-rays which contribute little to the disinfection process but do require shielding. When electricity is not being fed into the machine there is no radiation being produced; therefore, once the machine is off regular maintenance can take place without any special precautions to protect against radiation exposure. There is no radioactive material present (Priede-Segewick 1981). More information is available on the electron beam irradiator in Appendix 10.3.

At an electron beam pilot facility in Boston and at various industrial irradiators, there has been no measurable radiation exposure to the workers. There also has been no radiation exposure rate discernible above background levels outside the facility (by phone, Bob Fernald, High Voltage Engineering, 28 July 1981).

In an accident scenario, electricity would be shut off and therefore irradiation would stop, thus greatly reducing the possibility for overexposure. There is no radioactive material that could be released. Throughout over 15 years of experience in industrial facilities there has been only one case of overexposure. This accident occurred over 15 years ago when a worker was taken through an irradiator on a conveyor belt. Irradiators have been corrected so as to avoid this type of accident (by phone, Bob Fernald, High Voltage Engineering, 28 July 1981).

- Noise

Noise increase at Plant No. 2 from construction and operation of additional anaerobic digesters and dissolved air flotation units will be negligible. Doubling of these noise sources will increase the ambient noise level by approximately 3 dBA (USDOT 1973). Noise increases of 5 dBA or less are negligible (EPA 1978).

Montesa Park is zoned SU-1 (special use zoning), and there are no sensitive receptors (e.g., residences, schools, hospitals, etc.) currently located near the park that could be effected by an increase in the ambient noise levels at the park.

Both dedicated land disposal sites are zoned rural/agricultural. There are no sensitive receptors near these sites that would be affected by the increase in noise levels from the use of these areas as dedicated land disposal sites.

The landfill will exist whether or not it is used for sludge disposal. Sludge will be a very small percentage of the material disposed of at the landfill; therefore, the increase in noise caused by sludge disposal will be negligible.

Truck transportation associated with the various options is the major source for potential impacts from increases in ambient noise levels, since there are sensitive receptors along the truck routes. However, the anticipated increases in noise levels for roads associated with the various routes are less than 2 dBA. Increases of less than 5 dBA are negligible; therefore, noise impacts are considered insignificant.

6.5 BIOLOGICAL RESOURCES

6.5.1 Existing Conditions

Due to a large variation in elevation, land form, and soil in the Middle Rio Grande Valley, there is a large diversity in biological resources. In addition, moisture plays an important role and is perhaps the most important ecological variable. In the Albuquerque area the more productive communities occur near the Rio Grande River.

A gradual change in land cover occurs as elevation decreases from the mountainous terrain to the Rio Grande River Basin (Figure 6-5). Land at elevations between 9,000 and 6,100 ft is covered by pinyon-juniper or

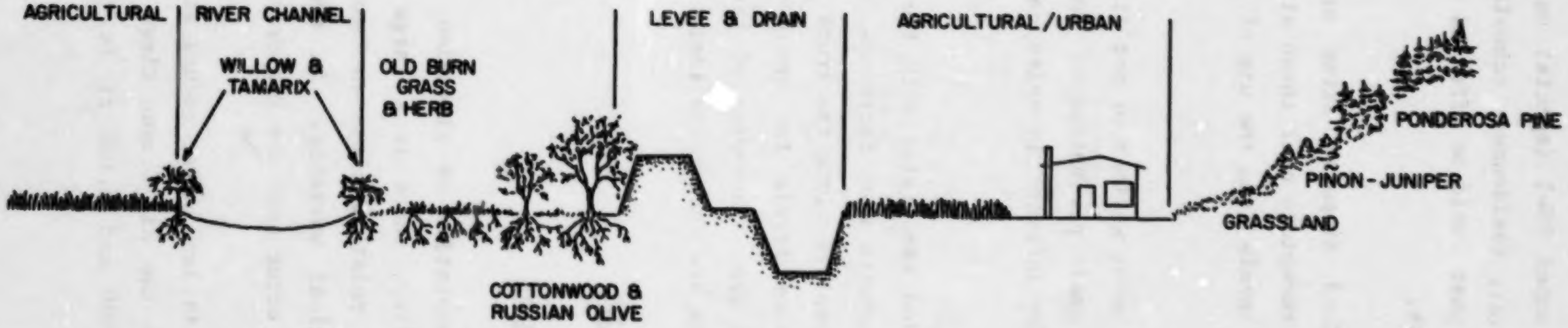
AGRICULTURAL
RIVER CHANNEL
WILLOW & TAMARIX
OLD BURN GRASS & HERB
COTTONWOOD & RUSSIAN OLIVE
LEVEE & DRAIN
AGRICULTURAL/URBAN
GRASSLAND
PIÑON-JUNIPER
PONDEROSA PINE

Figure 6-5. Profile of the land cover of the Middle Rio Grande River Valley near Albuquerque, New Mexico.

Source: USEPA. No date. Technical reference document for Albuquerque wastewater treatment faciltiies. Albuquerque, New Mexico, variously paged.

ponderosa pine forest. Common animals include the muledeer, desert cottontail rabbit, Pinyon Jay, Pigmy Nuthatch, and tree lizard. Grasslands are the predominant land cover between 6,400 and 5,100 ft, and common animal species include blacktailed jackrabbit, coyote, pronghorn antelope, Mourning Dove, and Mockingbird. Land at elevations between 5,100 to 4,900 ft are used for urban and/or agricultural purposes. Riparian woodlands border the Rio Grande River and adjacent aquatic habitats. Urban/agricultural land hosts few native species, but the productive riparian habitat supports species such as willow, Rio Grande cottonwood, salt cedar, and Russian olive. Important animal species are the beaver, raccoon, gray fox, coyote, as well as a number of waterfowl species. The fishery resource is not significant in the Rio Grande River and associated marsh, drains and canals. Some fish species (e.g., catfish, carp, sunfish) occur naturally, while rainbow trout and brown trout are present due to winter stocking efforts. A more detailed list of biological resources including land cover, physical characteristics, and animals is presented in Table 6-11.

Regarding endangered species, the US Fish and Wildlife Service was contacted in August 1980 for information about species listed or proposed to be listed that might occur in the project area (i.e., Bernalillo County). Their response (see Appendix 10.1) stated that no listed or proposed species would be affected by Albuquerque proposed sludge management system.

The two sites evaluated as dedicated land disposal sites (Rio Puerco and Pajarito) are classified as grassland types (MRGCOG 1978). Dominant plant species include black grama, blue grama, galleta, side-oats grama, dropseeds, and salt-brush. Animal species in this habitat include the coyote, blacktailed jackrabbit, striped skunk, American Kestrel, Western Meadow Lark, Scaled Quail, and Loggerhead Shrike. Typical reptile species include the western diamondback rattlesnake, western box turtle, and western spadefoot toad.

A field investigation of Montesa Park and the Tijeras Arroyo site on 12-13 February 1981 revealed the typical vegetation species on this shrubland site to include sagebush, creosote bush, tumbleweed, and various xeric grass species. Most areas along the route were bare or sparcely covered by

Table 6-11. Existing biological resources in the middle Rio Grande Valley near Albuquerque, New Mexico.

Land Cover	Location and Physical Characteristics	Undisturbed Vegetation	Mammals	Birds	Reptiles and Amphibians	Invertebrates and/or Fish
Forest (includes pinon-juniper woodland & ponderosa pine forest)	Sandia Mts. & foot hills. Slope generally steep but also rolling hills. Soils shallow to deep, fine sandy loam to very stony loam surface layer. Granite outcrops common. Elev. 6100 to 9000 ft.	Pinon pine, one-seed juniper, ponderosa pine, gambel oak, sideoats grama, dropseeds, prickly pear, mountain mahogany, Apache plume, woods rose, scarlet penstemmon.	Western pipistrelle, desert cottontail, mule deer.	Prairie Falcon, Peregrine Falcon, Band-tailed Pigeon, Hairy Woodpecker, Cassen's Kingbird, Scrub Jay, Pinon Jay, Stellar Jay, Pigmy Nuthatch, White-crowned Sparrow.	Shorthorned lizard, tree lizard, plateau whiptail, smooth-green snake, gopher snake, black-tailed rattlesnake, western spadefoot toad.	Similar to above. Also bark beetles, cicada, aphids, deerflies, leaf hoppers, tent caterpillar, sow bugs, earthworms.
Grasslands (includes arroyos & valley-side grassland)	5100 to 6400 ft. elev. Greatest portion of the study area above the floodplain of the Rio Grande and below the foothills of the Sandia Mountains Varied topography, slopes usually less than 10%, but greater near arroyos. Soils variable, fine sand and sandy-loam, to sand and gravel.	Black gamma or Indian rice, grass usually dominant, also galleta, dropseeds, blue grama, side-oats grama, four-winged salt-brush, broom snakeweed, rubber rabbitbrush, walkingstick cholla, dagger cholla, prickly pear, yucca, Apache plume, loco weed, stickleaf, mallow, horse nettle, doveweed.	Blacktailed jack-rabbit, spotted ground squirrel, prairie dog, silky pocket mouse, western harvest mouse, white-footed mouse, kit fox, coyote, pronghorn.	Kestrel, Furruginous Hawk, Burrowing Owl Scaled Quail, Road-runner, Mourning Dove, Mocking Bird, Western Meadow Lark, Loggerhead Shrike, Horned Lark.	Western box turtle, lesser earless lizard, side-blotched lizard, horned lizards, coach whip, gopher snake, western diamondback rattlesnake, Western spadefoot toad.	Grasshoppers, carrion beetles, tenebrioned beetles, ants, robber flies, walking stick, praying mantis, spiders, moths, butterflies.
Rock Outcrops	Cinder cones and volcano cliffs on West Mesa. Slope gentle to nearly vertical. Soils shallow, rocky, derived from basalt parent material.	Galleta and black grama usually dominant, also dropseeds, Indian rice-grass, threeawn, blue grama, sideoats grama, four-winged saltbrush, winterfat, wolfberry, prickly pear, broom snake-weed.	Desert cottontail, rock squirrel, striped skunk, gray fox, ring-tail, coyote.	Same as above. Also Rock Wren, Prairie Falcon.	Same as above. Also eastern fence lizard.	Similar to above.

Table 6-11. Existing biological resources in the Middle Rio Grande Valley near Albuquerque, New Mexico (continued).

Land Cover	Location and Physical Characteristics	Undisturbed Vegetation	Mammals	Birds	Reptiles and Amphibians	Invertebrates and/or Fish
Valley Urban and Agricultural Lands	4900 to 5100 ft. in the Rio Grande River inner valley (floodplain). Little or no slope.		House rat, Norway rat, striped skunk.	House Sparrow, House Finch, Starling, Rock Dove, Common Crow.	Woodhouse's toad, garter snake.	Household and agricultural insects, soil invertebrates, etc.
Valley Riparian Woodland	4900 to 5100 ft. in and adjacent to the floodway of the Rio Grande River. Little or no slope.	Rio Grande cottonwood, willows, Russian olive, salt cedar, curly dock, yerba mansa, Virginia creeper, alkali sacaton, sand dropseed.	cotton rat, Norway rat, white-footed mouse, desert cottontail, beaver, raccoon, gray fox, coyote.	Common Flicker, Steller Jay, Scrub Jay, Common Crow, Great Blue Heron, Black-crowned Night Heron, Gambel Quail, Ringneck Pheasant, Mourning Dove, American Robin, White-crowned Sparrow, Blue Grosbeak, Black-headed Grosbeak, Marsh Hawk, Cooper Hawk, Roadrunner, Starling, House Sparrow.	Woodhouse's toad, Western spadefoot toad, tiger salamander, bullfrog, whiptail lizard, eastern fence lizard, gopher snake, garter snake.	Beetles, grasshoppers, moths, ants, butterflies, spiders, earthworms, aquatic insects, mosquitoes.
River	Rio Grande River low flow channel. Flowing stream with interspersed mudflats. Flow rate: slow, 3-8 mph. Turbidity: high TemperatureL 13° C Bottom: silt & sand deposit Depth: 0-10 ft.	Algae, cattails, sedges, reeds, rushes	Beaver, muskrat, raccoon.	Great Blue Heron, Black-crowned Night Heron, Mallard, Teals, Pintail, Northern Shoveler, Killdeer, Common Snipe, Spotted Sandpiper.	Garter snake, bullfrog, leopard frog.	Tubifex worms, crayfish, snails, Carp, catfish (high turbidity during most of the year is limiting factor).

Table 6-11. Existing biological resources in the Middle Rio Grande Valley near Albuquerque, New Mexico (concluded).

Land Cover	Location and Physical Characteristics	Undisturbed Vegetation	Mammals	Birds	Reptiles and Amphibians	Invertebrates and/or Fish
Drains & Canals	Both sides of Rio Grande and throughout inner valley. Man made channel 10-30 ft. wide. Flow rate: slow to moderate, 5-10 mph. Turbidity: Low to moderate. Temperature: 15° C	Algae, cattail, rushes, sedges, hornwort, stonewort, milfoil (margin plants are removed by periodic dredging).	Muskrat, Norway rat, striped skunk.	Occasional ducks, Common Snipe, Belted Kingfisher, Great Blue Heron, Black-crowned Night Heron	Garter snake, bull frog, leopard frog, spiny softshell turtle.	Tubifex worms, snails, crayfish, Rainbow & brown trout (stocked in winter) catfish, carp, chub, bluegill, largemouth bass, dace, mosquito fish.
Cattail Marsh	37-acre marsh at outfall of Corrales drain N.E. of U of Albuquerque; scattered & intermittent small remnants along river & drains.	Algae, cattail, reed, rushes, sedges, spike rushes, duckweed, milfoil, stonewort, hornwort.	Beaver, raccoon, muskrat, cotton rat, western jumping mouse, striped skunk.	Great Blue Heron, Black-crowned Night Heron, Snowy Egret, ducks, Common Snipe, Spotted Sandpiper, Killdeer, Virginia Rail, American Coot, Redwing Blackbird, Common Yellow-throat, Rough-winged Swallow.	Garter snake, spiny softshell turtle, painted turtle, tiger salamander, bullfrog, leopard frog.	Tubifex worms, snails, crayfish, dragonflies. Rainbow & brown trout (from drains) catfish, carp, chub, bluegill, largemouth bass, dace, mosquito fish.
Swift Stream	Tijeras Creek. Narrow, shallow mountain stream.	Algae, watercress, sedges, rushes, willows.	Raccoon, striped skunk.		Garter snake, western spadefoot toad, red spotted toad, canyon tree frog.	Stoneflies, caddisflies, water penny, Uncertain; might support cold water species such as trout, dusky dace, mountain suckers, etc.

vegetation. Animals observed included the blacktailed jackrabbit, coyote, Redtailed Hawk, and American Kestrel. There was considerable evidence of small game hunting.

Pipeline and road right-of-ways were not surveyed outside of the Montesa Park area. Plant and animal species will vary for each alternative, but will be primarily a mixture of grass, shrub, and agricultural species. Plant and animal species inhabiting the landfill site can not be determined until site selection is finalized.

6.5.2 Environmental Consequences of the No-Action Alternative

Effects to terrestrial biota from the no-action alternative will be minimal. Primary adverse consequences from this alternative will result from a decrease in surface water quality due to contaminated runoff from stockpiled sludge and an inadequately treated wastewater discharge. Terrestrial species using (drinking, resting, foraging, etc.) the affected waters will be exposed to increased levels of toxic elements and potential pathogens.

Aquatic biota will be more adversely affected by the decline in water quality. Inadequately treated sewage and the warm, shallow, slow flowing nature of the Rio Grande River during much of the year will provide conditions conducive to low concentrations of dissolved oxygen. This potentially will result in a reduction in distribution of species present in the river, a reduction in abundance of certain other species (stone flies, caddis flies, etc.), and an increase in abundance of more tolerant organisms such as dipterans and tubificid worms. Additional adverse effect to the aquatic community will result from increases in suspended solids causing a reduction in numbers and types of benthic species.

6.5.3 Environmental Consequences of the Action Alternatives

Table 6-12 describes potential effects that could occur due to construction and/or operation of various sludge treatment options. An evaluation was conducted to determine the effects that may occur due to implementation of each alternative, based upon the options involved and using the

Table 6-12. Potential biological effects of various options.

Option	Potential Effects
Dissolved Air Flotation	• no effect
Anaerobic Digestion	• no effect
Organic Polymer	• no effect
Lime/FeCl	• no effect
Truck Transportation of Sludge	• increased road kills • increased dust from trucks • contamination from spilled sludge and refractory hydrocarbons • increased stream sedimentation, dust, and vegetation removal from construction • increased human intrusion
Pipeline Transportation of Sludge	• increased sedimentation, vegetative loss, habitat loss from clearing and pipeline construction
Belt Press	• no effect
Filter Press	• no effect
Solar Greenhouse Drying	• no effect
Open Air Drying	• increased flies, gnats and other nuisance/vector species

Table 6-12. Potential biological effects of various options (concluded).

Option	Potential Effects
Cesium Irradiation	• no effect
Electron Irradiation	• no effect
Composting	• no effect
Landfilling of Sludge	• no effect
Dedicated Land Disposal	• increased sediment, nutrients, toxic elements, and pathogens from surface runoff (if no runoff control is implemented) • increased dust • loss of vegetation and wildlife habitat

information in Table 6-12. The results of the evaluation are presented in Table 6-13, and can be summarized as follows: The dedicated land disposal options have the greatest potential for environmental impact because vegetation and wildlife habitat will be lost on approximately 3580 acres. Additionally, these DLD sites offer the greatest potential for impacting fish and wildlife if no runoff control is implemented. Other impacts are considered minor.

6.6 CULTURAL RESOURCES

6.6.1 Existing Conditions

Bernalillo County contains a wealth of cultural resources (prehistoric, historic and architectural). The county is within the Albuquerque District of the Middle Rio Grande Archaeological Unit (Cordell 1979) and shares a common heritage with areas further north and south along the Rio Grande Valley. The cultural resources span some 15,000 years of human prehistory and history and evidence has been found in various parts of the county for Paleo-Indian, Archaic, Anasazi/Mogollon, and Historic occupations. The cultural resources of Bernalillo County were concisely summarized in Section G-1 of the 1977 EIS (EPA 1977b). Other reports pertaining to the cultural resources of Bernalillo County include Cordell (1979, 1980), Tainter and Gillio (1980), Rodgers (1980, 1981), Judge (1973), Reinhardt (1967a, b and 1968), Fisher (1931), Cambell and Ellis (1952), Wetherington (1968), and Beck and Haase (1969). This list is not exhaustive; rather, these are the studies used in the preparation of this section.

Currently, Bernalillo County has 23 sites (including 1 district) listed on the National Register of Historic Places, and another site that is considered eligible. None of these are in any of the areas considered for the optimal alternatives as sludge treatment or disposal sites. The New Mexico State Historic Preservation Bureau has files on another 99 sites (New Mexico State Historic Preservation Bureau, Property Inventory by County, Revised August 1980). In addition, Section G-1 of the 1977 EIS (EPA 1977b) documented 56 sites on file with the Laboratory of Antropology, Museum of New Mexico; and 34 sites with the Survey Records, Department of Anthropology, University of New Mexico.

Table 6.13. Effects of optimal alternatives for the City of Albuquerque sludge managmenet program on biological resources.

No.	Effect Alternative	Disturbance of Wildlife and Increased Road Kills	Wildlife Contamination From Spilled Sludge	Increased Irritation From Vehicle Dust	Loss of Vegetation From Land Clearing	Loss of Vegetation From Erosion and Pipeline Maintenance	Increased Sedimentation and Turbidity Affecting Aquatic Organisms	Increased Nutrients Affecting Aquatic Plants and Animals	Increase in Nuisance Plants and Animals	Toxic Element Bioaccumulation	Fish and Wildlife Pathogen Contamination
1	1A	o	o	o				o		o	
2	1B	o			o	o	o	o		o	
3	1C	o	o	o				o	o	o	
4	1D	o			o	o	o	o	o	o	
5	1E	o	o	o				o		o	
6	1F	o			o	o	o	o		o	
7	1G	o	o	o				o	o	o	
8	1H	o			o	o	o	o	o	o	
9	2A	o	o	o							o
10	2B	o	o	o							o
11	3A	o	o	o	o		•	o	o	o	•
12	3B	o			o	o	•	o	o	o	•
13	3C	o			o	o	•	o	o	o	•
14	3D	o	o	o	o		•	o	o	o	•

o Potentially minor effect • Potentially serious effect

In the 1977 EIS (EPA 1977b), seven different topographic-environmental zones were identified in Bernalillo County. These zones included Upland Mountains, Lowland Mountains, Volcanic Mesas, Alluvial Fans Mesa, Sand Plains Mesa, Valley Sides and Terraces, and Valley Flood Plains. Section G-1 of the 1977 EIS documented the presence of archeological sites in all zones except for the Upland Mountains and the Alluvial Fans Mesa. However, as pointed out in Section G-1, the lack of recorded sites does not mean that sites are not present; it simply means that there have not been sufficient archaeological investigations in those areas to document the presence of sites. Investigations in similar zones elsewhere in New Mexico (Cordell 1979, Tainter and Gillio 1980) and in Bernalillo County (Rodgers 1981) subsequent to the 1977 EIS indicate that sites potentially may be present in the Upland Mountains and the Alluvial Fans Mesa.

Section G-1 of the 1977 EIS (EPA 1977b) was a general overview of the cultural resources of Bernalillo County. However, certain aspects of the optimal action alternatives being considered in the present document will directly affect cultural resources in the areas under study. Those aspects that will affect cultural resources include the method of transport and the method of disposal. Because specific disposal sites are being considered, the effects on cultural resources in these sites will have to be addressed.

6.6.2 Environmental Consequences of the No Action Alternative

If the city should take no action, then impacts to cultural resources from a sludge management system will not occur.

6.6.3 Environmental Consequences of the Action Alternatives

Potential effects on cultural resources will depend on the method of transportation used (trucking or piping) and the method of disposal (the site selected). Potential effects from the different options for transportation and disposal are listed in Table 6-14. The effects that may occur for each alternative are listed in Table 6-15. Although specific transportation routes and disposal sites have been selected (except for the municipal landfill site), only the pipeline route and sludge treatment site

Table 6-14. Potential adverse effects of the optimal alternatives on cultural resources.

A. Transportation

1. Trucking

- Construction of new routes or modification of pre-existing routes may affect sites in the right-of-way.
- Road construction may ease access and possibly subject sites to looting.
- Travel over non-paved roads may increase erosion which, in turn, may affect sites in the vicinity of eroded area.

2. Pipeline

- The construction of the pipeline may impact surface and buried sites in the right-of-way.
- Sites adjacent to the right-of-way may be subjected to looting during construction.

B. Disposal

1. Landfill

- The excavation of a landfill site may impact all sites in the project boundary.
- Sites adjacent to the project may be subject to looting.

2. Dedicated Land Disposal

- Driving trucks over the project site and the injection of liquid sludge may impact all sites within the project boundary.
- Sites adjacent to the project may be subject to looting.

Table 6-15. Effects of optimal alternatives for the City of Albuquerque sludge management program on cultural resources.

		Effects					
		Transportation		Application			
No.	Alternatives	Affecting Surface Sites in the Right-of-Way	Affecting Buried Sites in the Right-of-Way	Affecting Surface Sites Landfill	Affecting Subsurface Sites Landfill	Looting	Erosion
1	1A						
2	1B		●			o	
3	1C						
4	1D		●			o	
5	1E						
6	1F		●			o	
7	1G						
8	1H		●			o	
9	2A	●	o	●	o	o	o
10	2B	●	o	●	o	o	o
11	3A	●	o	●	●	o	o
12	3B	●	●	●	●	o	
13	3C	●	o	●	●	o	o
14	3D	●	●	●	●	o	

o Not significant
● Significant

(Montesa Park) related to the Group 1 alternatives have been surveyed for cultural resources (Banks 1981). No investigations have been conducted in conjunction with the other pipeline routes, DLD sites, or landfill sites.

- **Method of Transportation**

Two different methods of transport have been proposed: truck and pipeline. Either may potentially have a negative impact on cultural resources if new construction is involved (Table 6-14) as such construction could result in the destruction of any sites along the right-of-way.

- Truck Transportation

Trucking will not result in a negative effect if the haul routes follow preestablished paved roadways. However, if these routes need to be modified, if new routes are to be constructed, or if unpaved routes are modified, expanded or paved, cultural resources in the right-of-way may be negatively effected by construction activities. Further, the accelerated activity will increase access to the area selected for disposal and possibly subject sites in the vicinity to looting. Increased activity along dirt roads may also accelerate erosion thus indirectly subjecting sites in the vicinity to threats of erosion. It is assumed that existing roadways would be utilized for trucking purposes.

- Pipeline Transportation

Pipeline construction could affect sites in the right-of-way, whether they are on the surface or buried (Table 6-14). Further, construction may subject adjacent sites to looting. Only one pipeline route, the Tijera Arroyo Interceptor, has been surveyed and cleared through archaeological investigations. Although no surface indications of cultural resources were found along this route, the potential for buried sites was noted. This survey report (Banks 1981) was reviewed by the SHPO who concurred with the findings (Appendix 10.1). Other pipeline routes have not been surveyed. However, they will cross the West Mesa where there is a potential for encountering sites.

- **Method of Disposal**

Cultural resources may be affected by the method of disposal (Table 6-14). The disposal alternatives evaluated include landspreading on city parks, landfill, and dedicated land disposal.

- Landspreading on City Parks

These alternatives should not adversely effect any cultural resources unless they involve undeveloped parks. However, these alternatives also involve the construction of sludge treatment facilities at Montesa Park. The proposed Montesa Park site was surveyed in February 1981 (Banks 1981). No surficial evidence of cultural resources were observed and it was found that the construction of sludge treatment facilities would not impact any cultural resources, except possibly those buried. The SHPO has concurred with these findings (Appendix 10.1).

- Landfilling

Since a new municipal landfill site has not been selected no reliable assessment of potential impacts can be made. The new landfill likely will be somewhere north of Albuquerque, on the Bernalillo-Sandoval County line, probably either in the Middle Rio Grande Valley or on the Llano de Albuquerque between the Rio Grande and the Rio Puerco. A disposal site in either of these areas will likely impact cultural resources. Surveys done in this general vicinity (Rodgers 1980, Reinhardt 1967a, b, 1980, Judge 1973, Fisher 1931, Cordell 1979, Tainter and Gillio 1980) indicate the potential of encountering sites.

- Dedicated Land Disposal

Two possible sites have been selected for land disposal; the Rio Puerco and the Pajarito sites. Both are on the Llano de Albuquerque, between the Rio Grande and the Rio Puerco, on the Sand Plains and adjacent to the Valley Sides and Terraces. Although neither site has had any intensive assessment made of cultural resources, Section G-1 of the 1977 EIS

(EPA 1977b) identified a number of sites in the general vicinity. Other investigations in adjacent areas (Campbell and Ellis 1952, Fisher 1931, Reinhardt 1967a, 1967b, 1968, Judge 1973, Rodgers 1980, Cordell 1979, Tainter and Gillio 1980) further substantiate the potential of cultural resources that may be affected if either of these sites is utilized.

As previously stated only the Montesa Park and Tijera Arroyo Interceptor have been surveyed. No surficial evidence of cultural resources was found in either of these areas; however, the possibility of encountering buried sites during construction was noted. With regard to the dedicated land disposal and landfill sites, as well as the pipeline routes for land disposal sites, survey work has not yet been performed. In order to protect cultural resources; EPA will condition any Step 2 or Step 3 grants awarded to require that survey work be performed (if not already complete) to the satisfaction of EPA and the SHPO. If cultural resources are identified that are potentially eligible for the National Register of Historic Places, the SHPO will be notified and the ACHP offered an opportunity to comment in accordance with 36 CFR 800. Further, if significant resources are encountered during construction, work potentially will be stopped and the SHPO and the ACHP consulted for an assessment of significance.

6.7 POPULATION

6.7.1 Existing Conditions

- City of Albuquerque

The City of Albuquerque experienced a dramatic change in population between 1940 and 1960 when the number of people increased from approximately 35,000 to over 201,000. In 1980 the City of Albuquerque had a population of 331,767 (USDOC 1981), an increase of 35.7% from 1970. During this same time period the State experienced a population increase of 27.8%. A population of between 393,201 and 427,618 is projected for the City in 1985 (EPA 1977). Increases of this magnitude would mean the City would have a population increase of 18.5% to 28.9% between 1980 and 1985.

The median age for the City of Albuquerque in 1980 was estimated to be 28.7 (Sales and Marketing Management 1980). Bernalillo County had a median age of 28.0, while the State of New Mexico had a mediam age of 27.5. An area with a median age under thirty is young and dynamic, and has the potential to stimulate population increase.

- Specific Treatment and Disposal Sites

The Albuquerque Area is divided into 411 Data Analysis Sub-Zones (DASZ) for population analysis and projections. Montesa Park, located in DASZ 8601, had zero population in 1975 and is expected to remain at zero in 1985. Treatment Plant No. 2 is in DASZ 5402 which had an estimated population of 631 in 1975. This zone is projected to have a population of 800 in 1985. DASZ 5411 is immediately east of Treatment Plant No. 2 between 2nd Street and Broadway. This zone had an estimated population of 785 in 1975, and is projected to have a population of 1,100 in 1985. The Pajarito site is in DASZ 5504, which had zero population in 1975 and is expected to remain at zero in 1985. The Rio Puerco site is outside the DASZ classification areas, but no residences are in the area. Residential areas are scattered throughout the northern part of the City where a landfill site might be located.

6.7.2 Environmental Consequences of the No Action Alternative

The City's no action alternative would cause the sludge management system to be overloaded by 13 mgd. The inadequacy of the existing wastewater treatment facilities would cause industries possibly to relocate away from Albuquerque, which subsequently would cause population to stagnate or decrease. In addition, the lack of adequate treatment capabilities may cause limitations to be placed on residential construction. An imposition such as this also would cause population growth to be stymied and would cause adverse effects on the economy.

6.7.3 Environmental Consequences of the Action Alternatives

The development of any of the 14 action alternatives will not cause an influx in population that substantially differs from the influx anticipated by population projections contained in the 1977 EIS (USEPA 1977a).

Adverse population impacts caused by displacement will be minimal under each of the 14 alternatives. Utilization of any of the disposal sites will not result in a relocation of people. Displacement caused by costly user charges (i.e., annual user charges exceeding 5% of annual income) is expected to be minimal.

6.8 LAND USE AND TRANSPORTATION

6.8.1 Existing Conditions

- **City of Albuquerque**

Urban development has been increasing in the project area which has caused a decrease in the amount of agricultural, rural and vacant land. The type of development that has occurred has caused much of the area to become a sprawling urban/suburban complex. The cropland that remains is mixed with urban/rural development in parts of the north and south valleys. Several large parcels of vacant grazing land occur on the mesas; however, most of these are being held for eventual subdivision or commercial development (USEPA 1977). Much of the other rural or open land is publically owned.

Single family residences are the predominant land use in the metropolitan area. Multi-family dwellings and retail outlets occur along the major streets, while most of the manufacturing and wholesaling activities are found near the Atchison, Topeka and Santa Fe railroad or near one of the major interstate highways/freeways. Offices are concentrated in the central business district and along both freeways.

Interstate 40 and Interstate 25 divide the city into four quadrants and provide access to arterial streets. The highest traffic volumes (over 80,000 vehicles per day) are at the intersection of the two interstate highways. The highest traffic volumes on main arterials also are at the intersections with the interstates. A major goal of the Comprehensive Plan is to produce a compact urban form that would place more reliance on mass transit than the individual automobile. Currently, only a modest bus service exists.

Four major airlines use the Albuquerque International Airport to provide air travel. The Chicago-Los Angeles mainline furnishes both passenger and freight rail service. A major new airport to serve primarily private aviation is planned to be built on the far west mesa (west of the volcanoes).

In 1975 the City and County adopted a new Comprehensive Plan to promote orderly development. The Comprehensive Plan contains a set of land use, environmental, and economic policies and goals which are intended to produce an attractive, diverse and efficient metroplex. Conformance to the principals contained in the Comprehensive Plan is one of the prime objectives of the wastewater management process.

Since development is more likely to occur where municipal services are available than where they are absent, the provision of city utilities can play a role in accomplishing the goals of the Comprehensive Plan. However, the lack of municipal services does not by itself prevent growth from occurring in areas where it is not desired. Municipal services used in conjunction with the Comprehensive Plan, zoning subdivision regulations and other measures produce orderly development.

- Specific Sludge Treatment and Disposal Sites

Montesa Park is a 575 acre City-owned parcel about 5 miles east of Treatment Plant No. 2. Activities at this site consist of a gun club firing range, office and shop of the Vector Control Division of the municipal Department of Environmental Health, and an apprentice training center. The U.S. Forest Service has built a tree nursery on 222 acres at the eastern end of the property. The Tijeras Arroyo traverses Montesa Park from east to west and drains into the Rio Grande River. Kirtland Air Force Base is located north of Montesa Park, the Sandia Military Reservation is to the east and the University of New Mexico owns a large track of land to the south. Montesa Park currently is remote from residential areas and is expected to remain as such (CDM 1980a). However, a 1,350 unit mobile home park is being proposed south of the Tijeras Arroyo. The proposed facilities at Montesa Park are slightly over a mile from the eastern boundary of the mobile home park.

Montesa Park and the area to the north is within municipal jurisdiction, and is zoned M-2, heavy industrial (Albuquerque/Bernalillo County Planning Department 1977). The area to the south of Montesa Park is zoned A-1, rural and agricultural by the Bernalillo County Planning Commission (Vanervan, J. 1981).

A part of Montesa Park is in the 100 year floodplain; however, none of the proposed construction activities are located in the floodplain. In addition, none of the land is considered to be prime or unique farmland (US Department of Agriculture 1980). Access to Montesa Park is provided by Los Picaros Road.

The area north of the City where a landfill site might be chosen contains a mixture of rural residential and agricultural land. The landfill site will be outside the jurisdiction of the City and would be under the land use control of the Bernalillo County Planning Commission. Transportation of the sludge would occur along Interstate 25. New industries in the northern part of the City are anticipated to cause major traffic jams on the frontage roads along Interstate 25.

Land use surrounding both the Rio Puerco and Pajarito sites is undeveloped grassland and shrubland (Middle Rio Grande Council of Governments of New Mexico 1979). There are no residences near the site. Access to the Pajarito site would be provided by Padillas Road, while access to Rio Puerco would be provided by a lightly used rural road. Both of these sites are under the land use jurisdiction of the Bernalillo County Planning Commission and are zoned A-1, rural and agricultural.

6.8.2 Environmental Consequences of the No Action Alternative

The continued use of the existing facilities without a sludge management program would cause the treatment plant to be overloaded by 13 mgd. In addition, other less efficient forms of sewage treatment, such as septic tanks or lagoons, might occur in response to try and relieve the overload. This form of sewage treatment could cause inefficient, low density urban sprawl to occur, a type of development that is not in accordance with the Comprehensive Plan. Inadequate sewage treatment facilities can deter growth, but they will not keep it from occurring. Therefore, the City of Albuquerque might continue to grow without improvements to sewage treatment facilities, but it would not be a healthy form of development. Inadequate sewage treatment facilities could also cause the population to decrease, which would cause land values to also decrease.

6.8.3 Environmental Consequences of the Action Alternatives

The development of any of the optional alternatives will allow the City to properly accommodate future sewerage treatment needs. The development of the alternatives could, however, produce some adverse effects on transportation and land use. Possible adverse effects caused by various treatment and disposal options include:

- A pipeline to either Pajarito or Rio Puerco will intersect water and sewer lines at Coors Boulevard and Gun Club Road. If breakage should occur to one of these lines service would be disrupted for residents south of Gun Club Road.

- If trucks use Prosperity between 2nd Street and Broadway Boulevard they will pass through a residential area. The impact could be minimized if trucks would take 2nd Street to Rio Bravo Boulevard to Broadway Boulevard.

- Trucks, as well as the pipeline, will disrupt the residential area along Lakeview Road and Gun Club Road on the way to Pajarito. This impact would be lessened if trucks would take Rio Bravo Boulevard to Coors Boulevard. In addition, traffic will be increased along Isleta Boulevard by Harrison Junior High School if the Pajarito site is used.

- A pipeline to Rio Puerco will disturb the residential area along Lakeview Road and Gun Club road. In addition, construction of a pipeline to Rio Puerco or Pajarito will pass by Harrison Junior High School, which may cause disruptions during construction. In addition, the possibility of someone falling into an open trench is greater.

- A total of 47 round trips by truck per day will be needed to haul liquid sludge between Plant No. 2 and Montesa Park, Pajarito, or Rio Puerco. The trip to Rio Puerco will require trucks to pass through one of the highest traffic volume areas in Albuquerque, thereby increasing the possibility of accident. Disposal at a landfill site will require trucks to pass through the same high traffic area. However, only 5 to 9 round trips per day will be needed.

- Trucks might have to use a highly congested frontage road along Interstate 25 for disposals at the landfill site. Five to 9 trucks will use the landfill site per day; 200 to 300 trucks per day use the present landfill site (by phone, V. Brown 1981). Therefore, the addition of 5 to 9 trucks will have a minimal impact.

- If the open air or composting methods attract birds, these uses would be incompatible at Montesa Park with the adjacent airport. Current information regarding bird strike hazards near composting operations indicates this should not be a problem.

- Both Pajarito and Rio Puerco are zoned rural and agricultural. This zoning will have to be changed to allow for the disposal of sludge. The change will not cause a conflict with adjacent land uses.

The effects of each of the 14 action alternatives on transportation and land use are designated in Table 6-16.

Table 6-16. Effects of the action alternatives on transportation and land use.

	Transportation									Land Use			
	Disrupt Services			Penetrate Sensitive Urban Areas				Streets					
Alternative	Water	Sewer	Streets	Neighborhoods	Schools	Hospitals	Parks	Traffic Increased	Improper Use	Decrease Land Use	Incompatability with Existing Land Use	Conflict with Existing Zoning	Effect Prime Farmland
1A				●				●	●				
1B													
1C				o				●	●				
1D													
1E				●				●	●				
1F													
1G				●				●	●				
1H													
2A				o				o					
2B				o				o					
3A				●	o			●	●	o		o	
3B	o	o	o	●	o					o		o	
3C	o	o	o	●	o					o		o	
3D								●		o		o	

● - Major Effect
o - Minor Effect

6.9 ECONOMICS

6.9.1 Existing Conditions

- **General Economic Activities and Trends**

The Albuquerque area economy has weakened during 1980. Total employment between November 1979 and October 1980 declined for both the area and the State, although there were more people available for work. The unemployment rate reached a high of 8.4% in the Albuquerque area which was above the State high of 7.8% and well above the unadjusted national average of 7.1% in November 1980. Unemployment increased significantly between 1979 and 1980.

The construction industry began declining since fall 1979 and has continued with this trend. Building permits in all three segments of the industry began to decline in 1979 reversing the positive trend experienced between 1976 and 1979.

During the first half of 1980, residential building declined approximately 64% over the same period in 1979. However, several large commercial projects are underway and several more are planned. These will be providing added employment opportunities for the construction industry in the months to follow.

The Albuquerque area population demonstrated a continual but slow growth pattern; however the economy has slowed considerably since 1979. Incomes have risen annually, but the increases have not kept pace with inflation in all years. In general, New Mexico ranked 38th in the nation for average personal income in 1979, an improvement from 43rd the previous year. The numbers of households within the lower disposable income categories are decreasing while those in the higher disposable income categories are increasing.

- **City-Finances**

The FY81 budget of Mayor David Rusk does not propose any new program responsibilities for the City government. The total operating budget recommended for FY81 is $180.2 million. The recommended general fund budget is $89.5 million and anticipated general fund revenues are $90.2 million. This budget represents an increase of nearly 9% over the FY80 budget. This is substantially below the inflation rate in New Mexico and in the nation as a whole.

The current administration has a new capital projects policy which is in response to tremendous increases in the operating budget over the last two years. New policies are aimed at assuring that program and service operations are financially self-sufficient wherever practicable.

The City of Albuquerque does not depend on local property taxes to any meaningful extent. This is in contrast to many other metropolitan areas in the US which tend to rely heavily on local property taxes. The city budget indicates changes in the composition of revenues, including the growing importance of gross receipts, taxes, and charges for services rendered.

The 1980 overall tax rates for ad valorem taxes in the City of Albuquerque ranged from 32.574 to 69.803 per $1,000 of assessed valuation. The variation occurs due to differential tax rates for school districts. The average ad valorem tax rate in the Albuquerque area for 1980 was 45.594 per $1,000 of assessed valuation.

- **Water and Sewer Operating Fund**

The joint water and sewer operating fund is separate from the general fund. More than 90% of total revenues come from fees and user charges levied on customers utilizing water and sewer services. Capital transfer from the general fund represents less than 1% of total water and sewer revenues. Liquid waste operations represent 18% of total appropriations.

Water and sewer requirements accounted for 60% of total revenue bond issues and 7% of general obligation bond issues as of 1 July 1980. Total outstanding debt amounted to $149,765,000, and the water and sewer portion amounted to $20,475,000, or 49% of the total outstanding debt. In the City's 1979 bond election, a total of $118,284,018 in bonds were floated, with 60% of these revenues appropriated for water resources.

Approximately 2 to 8 million dollars of revenue bonds will be floated to cover the local share of an action alternative. This is based on EPA construction grant participation of 75% to 85%, and State grant funds of 12.5%. The anticipated debt retirement schedule cannot be determined until the actual floating of bonds. At that time the cash flow schedule will be determined and goals developed. There will not be any transfers from the general fund and/or other funds to the Joint Water and Sewer Operating Fund.

The average monthly water and sewer bill for a residential user is $14.70. The portion of the bill allocated due to water services is $9.63 (65%), and the portion of the bill allocated to sewer services is $5.08 (35%) on the average. A new City ordinance (Council Bill No. 0-129. Enactment No. 19-1981) has been adopted to include provisions for water credits for low income households, effective 3 March 1981. Qualified households will have a credit of $2.00 per month applied to their billing. The billing will be calculated using the fixed monthly charge and the commodity charge only.

6.9.2 Environmental Consequences of the No Action Alternative

If the wastewater treatment system and sludge management system does not expand from 47 mgd to 60 mgd, additional growth in the Albuquerque service area would not be able to occur. A limited population growth would prevent growth of the economy and expansion of the industrial base. In turn, the tax base would not expand, and thus the existing tax base would have to provide all revenues required by the City to operate community and social services. A reduction in the quantity and quality of community and social services provided by the City potentially would occur as a result of implementing the no action alternative.

6.9.3 Environmental Consequences of the Action Alternatives

The overall socioeconomic effect of the implementation of any of the 14 action alternatives is that the City can continue to grow and expand. The collection and treatment systems will be adequate to accommodate population increases and economic diversification and expansion. The impacts on the social fabric of the community and the economy are a result of an alternative being implemented in its entirety, as opposed to effects resulting from each separate process within a particular alternative. As a result, impacts described in this Section are discussed under general economic and social indicators, as either direct or secondary effects which are beneficial or adverse to the Albuquerque community.

- Direct Impacts

Capital costs which will be incurred by the City of Albuquerque will include the cost of designing, purchasing, and constructing equipment for treatment processes, buildings and sitework for treatment and disposal processes, equipment for transportation of sludge (including trucks or a pipeline), and land acquired for pipeline construction or for additional landfill or dedicated land disposal facilities. Operation and maintenance costs which will be incurred by the City will include the the cost of fuel, labor, chemicals, and repair involved with treatment processes, transportation of sludge, and disposal processes. The total capital costs for a sludge management system will vary from 18 to 31 million dollars. The sludge system is part of a larger Phase II expansion plan that also includes collection systems and treatment facilities which will cost an estimated $70-80 million. The City of Albuquerque was able to float sufficient bonds in 1977 to fund the total Phase II expansion package. The City does not anticipate having any difficulty floating bonds for an additional $2-8 million for a sludge management system (by telephone, Art Blumenfeld, Director of Finance and Management, City of Albuquerque, August 1981).

Federal government expenditures will involve a maximum of $23.5 million dollars (75% grant for capital costs of Alternative 3B). If innovative technology is utilized then 85% of that technology will be funded, and 75% of the remaining capital costs will be funded (totalling a maximum of $21.7 million for alternative 1B). State government expenditures will involve 12½% of the capital costs to a maximum of $3.9 million.

Cost of sewage service will increase for all residential, commercial and industrial users. The equivalent monthly cost per connection of the 14 action alternatives will range between approximately $0.50 - $4.00 depending on the market value of the sludge (if any) and upon what Federal and state funding is received (see Table 6-17). This cost range does not represent a significant economic burden and is well within EPA guidelines (as promulgated in Program Requirements Memorandum #79-8, Office of Water and Hazardous Materials, Washington DC).

Additional short-term effects that will be incurred by the City include: short-term increases in employment in the local construction industry will be realized; increased receipts for local industries supplying materials and equipment for construction, treatment, transportation and disposal processes will occur; and the City of Albuquerque will be better able to absorb increased growth in population and employment.

- Secondary Impacts

  - Land Values

The value of land is determined by the supply and demand for land and the type of use for which it is zoned. Values are also affected by the use of adjacent lands; for example, tracts used for dedicated land disposal, landfill sites and treatment sites may, in turn, decrease the value of adjacent properties which are perceived as less desirable locations during the operation of the treatment or disposal activities. Potential effects of the action alternatives on land values include: the value of lands adjacent to the landfill disposal site(s) and the dedicated land disposal sites potentially will decrease during disposal operations; and all three groups of alternatives will permit growth to occur, thereby generally increasing the value of residential, commercial and industrial properties.

Table 6-17. Equivalent monthly average increase per connection for each alternative system, based on different funding arrangements.

Alternative	No EPA funding, 12.5% state funding. Sludge=$0 per ton*	75/85%** EPA funding, 12.5% state funding. Sludge=$0 per ton*	50% EPA funding, 12.5% state funding. Sludge=$0 per ton*
1A	$3.22	$1.60	$2.08
1B	3.03	1.38	1.87
1C	2.99	1.58	1.99
1D	2.80	1.35	1.78
1E	3.76	2.52	2.94
1F	3.00	1.71	2.14
1G	3.21	1.74	2.23
1H	3.03	1.52	2.02
2A	2.53	1.44	1.81
2B	2.34	1.24	1.60
3A	2.95	1.47	1.98
3B	3.26	1.64	2.20
3C	2.69	1.92	1.62
3D	2.87	1.45	1.92

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*if sludge is sold for $70 per ton, each household bill will be $0.63 cheaper.

**75% funding for all capital costs except innovative technology which is funded at 85% of cost.

- Tax Base

Effects upon the local tax base will include: increased land values will generate additional taxes thereby expanding the local tax base and increasing the amount of revenues raised; additional growth will require extension of community and public services thereby increasing local expenditures for the City; imbalances between City revenues and expenditures potentially will be adjusted by changing either the tax rate or the proportion of assessed valuation. This may result in an effective tax rate that is either higher or lower than the current rate depending upon the relationship between the size of the tax base and total expenditures; and increased population will result in additional monies from Federal revenue sharing programs (assuming the formula for computing Federal revenue sharing remains the same).

- Employment

Effects on employment will include: alternatives in Group 1 requiring the solar greenhouse would indirectly induce increased employment and earnings in the solar energy industry; if any alternative in Group 1 is selected, employment in the local fertilizer industry potentially will stagnate or decrease due to the City providing its own fertilizer for land spreading on City parks; all alternatives will induce employment in the Albuquerque area economy by permitting general growth; and economic growth and concommitant population growth will result in an increased demand for social services and community amenities such as education, housing, police; fire department, ambulance service, and health care delivery.

6.10 ENERGY RESOURCES

6.10.1 Existing Conditions

Under the existing sludge management system, energy is consumed by equipment pouring wet sludge on drying beds and removing solids from the drying beds. Fuel is consumed in transportation of dried cake to Montesa Park and in stockpiling. Fuel is also consumed transporting excess sludge from the treatment plant to the dedicated land disposal site presently in use, and by equipment at the disposal site. Energy consumption data are not available for the existing sludge management operations described above. Digester gas is collected and used for electric generation at wastewater treatment Plant No. 2. Approximately 450,000 cu ft/day is produced, or the equivalent of 860 kw. The remaining electrical demand by the treatment plant is satisfied by electricity purchased from the Public Service Company of New Mexico (PNM). Table 6-18 lists the electricity purchased from PNM in 1979 and 1980 for the treatment plant. For the twelve months between June of 1980 and May of 1981, monthly electrical demand of the treatment facility averaged 1,344 kw, ranging between 1,248 kw and 1,536 kw (by telephone, Alex Gonzalez, Public Service Co. of New Mexico, 16 July 1981). During the first eight months of 1979, 11,407,000 cu ft of natural gas was purchased for use at the plant. Approximately 60 gallons of diesel per day is currently consumed for sludge haulage from the treatment plant (by telephone, Chava Trucking, 20 July 1981).

6.10.2 Environmental Consequences of the No Action Alternative

If no action is taken, energy consumption will be similar to that described for existing conditions. Sludge will not be transported to a dedicated land disposal site due to termination of the lease, thus excess liquid sludge will be transported to nearby lagoons. This transportation will require energy; but, based on the relatively short distance from the digester and thickener to the lagoons, and the lack of sludge injection equipment involved, energy requirements assumedly will be less than under existing conditions.

6.10.3 Environmental Consequences of the Action Alternatives

Table 6-19 includes the anticipated electrical and fuel energy demands associated with each sludge management alternative. Power generated by digester gas is not included in the calculation. Table 6-19 does not include energy requirements for the wastewater treatment system. Energy requirements are not available for chemical feed pumps (polymer or

Table 6-18. Electric usage and costs for Albuquerque wastewater treatment plant No. 2 during 1979 and 1980.

	1979		1980	
Month	KWH	Cost($)	KWH	Cost($)
January	259,200	11,854.44	777,600	43,099.26
February	796,800	44,769.23	772,800	42,983.14
March	744,000	30,231.95	787,200	40,209.39
April	763,200	35,799.46	720,000	37,310.40
May	830,400	44,260.32	792,000	45,893.23
June	912,000	44,754.58	614,400	32,123.29
July	830,400	45,031.76	676,800	38,242.58
August	753,600	40,053.84	772,800	42,036.46
September	873,600	43,031.79	801,600	40,142.94
October	768,000	40,533.50	744,000	37,200.00
November	806,400	41,070.76	710,400	35,520.00
December	681,600	37,833.57	897,600	44,880.00

Source: City of Albuquerque and Gonzales, Alex. 1981. Telephone conversation, Alex Gonzales, Public Service Co. of New Mexico, 16 July 1981.

Table 6-19. Annual energy requirements for alternatives (not including wastewater treatment system requirements or power production using digester gas).

Alternative No.	Million KWH	Gallons Diesel	Gallons Propane	Total Cost*
1A	1.83	40,700**	0	$170,145
1B	2.24	0	41,600	183,392
1C	0.86	69,700**	0	132,095
1D	1.27	29,000**	0	117,445
1E	0.88	101,200**	0	166,540
1F	1.29	60,500**	0	151,890
1G	3.14	69,700**	0	288,275
1H	3.55	29,000**	0	273,625
2A	0.78	36,500***	0	91,755
2B	0.78	24,300***	0	78,945
3A	0.77	107,200	0	165,305
3B	1.38	13,800	0	109,020
3C	2.00	13,800	0	151,490
3D	0.77	119,800	0	178,535

* Cost based on $0.0685 per KWH, $1.05 per gallon of diesel, and $0.72 per gallon of propane.

** Does not include fuel for final stockpile equipment or landspreading.

*** Does not include fuel for landfill equipment.

lime/$FeCl_3$), stockpiling equipment, or equipment required during landspreading or landfilling. All sludge management components will require energy. Significant amounts of energy will be utilized by the final disposal options (landspreading, landfilling and dedicated land disposal), and transportation options. Less energy apparently will be required by the Group II alternative as compared to other alternatives.

The Public Service Company of New Mexico is currently capable of generating 20% above peak demand. Peak demand is approximately 937 MW. Therefore, the utility maintains a reserve at peak of approximately 187 MW. As shown on Table 6-19, the maximum electric consumption for sludge management associated with Alternative 1H is 3.55 million KWH per year. This demand represents approximately 0.2% of available reserve above peak (by telephone, Alex Gonzales, Public Service Co. of New Mexico, 16 July 1981), and thus will not affect electrical energy supplies in the project region. The consumption of diesel fuel and/or propane required by the various alternatives also will not affect available fuel supplies in the project region.

6.11 ENVIRONMENTAL HEALTH

6.11.1 Existing Conditions

The current sludge disposal system serving the Albuquerque area is inadequate for the amount of sewage generated by the current population. The present sludge management system is overloaded, inadequate, and may be presenting public health problems. It is emphasized that establishing a cause and effect relationship between deficiencies in the present system and existing public health problems (if any) in Albuquerque would be purely speculative and open to question.

Currently, there are no major epidemic-type health problems in Albuquerque. There is, however, a substantial amount of infectious hepatitus currently in the population of Bernalillo County. In 1977 there was a significant increase in hepatitus throughout the U.S.: however, the

Albuquerque area experienced a greater share of the problem than the rest of the U.S. (by telephone, Dr. N. Pressman, District Health Officer, Bernalillo County, 22 July 1981).

Various health effects associated with typical sludge treatment and disposal systems are described briefly in the following paragraphs.

- Sludge Treatment System

  - Stabilization: Anaerobic Digestion

The present sludge handling system does not include a specific disinfection process to remove pathogenic organisms; however, the stabilization process (anaerobic digestion) does remove moderate amounts of these pathogens. The stabilized sludge contains some or all of the following organisms and chemical constituents in amounts that may or may not be harmful to public health:

- Bacteria: Fecal coliform, Streptococal coliform, Salmonella sp., and Shigella sp.
- Viruses: Hepatitus.
- Parasites: Entamoeba histolytica; Ascaris lumbricoides.
- Chemical constituents: cadmium, arsenic, chromium, barium, zinc, lead, manganese, and iron.

  - Drying Beds

Following the stabilization process, sludge is placed on drying beds adjacent to the plant. Drying beds generate odors and dust containing pathogenic organisms, and attract vectors and mosquitoes. Groundwater leaching is prevented by liners in some beds

  - Temporary Storage Stockpiles

Sludge is piled up in temporary storage stockpiles adjacent to the drying beds before it is finally disposed. The stockpiles present similar problems to those of the drying beds; however, there can be an increase in the generation of dust as the sludge now contains less liquid.

- Sludge Disposal Systems

Disposal of nondisinfected sludge creates opportunities for contamination of the environment which may, in turn, adversely affect the health of the surrounding community. Potential effects from disposal options are:

- Storage Piles at Montesa Park

A portion of the total amount of sludge currently disposed is trucked to Montesa Park where it is stockpiled. These stockpiles represent a potential effect to environmental health: odor and significant amounts of dust containing pathogenic organisms are potentially generated; and the stockpiles can attract vectors (i.e., mosquitoes and flies) which can further spread disease. Lack of protective cover from rain may allow contaminated runoff to form, which in turn may contaminate surface water, if proper runoff collection and treatment systems are not utilized.

- Landfill and Dedicated Land Disposal

The remaining sludge currently generated at Plant No. 2 is permanently disposed either at the City's landfill or through dedicated land disposal methods on tracts of land leased from the State of New Mexico. The landfill and DLD methods of disposal of non-disinfected sludge currently used meet EPA regulations governing sludge disposal and are considered acceptable.

6.11.2 Environmental Consequences of the No Action Alternative

A decision not to expand the wastewater treatment system and sludge management system from 47 mgd to 60 mgd would have some definite effects on environmental health. The wastewater treatment system removes moderate to significant amounts of bacteria, viruses, protozoans and helminths. Treatment of the remaining sludge removes additional amounts of pathogenic organisms through anaerobic digestion. However, there is no disinfection process in the current system, and pathogens remaining in the sludge can survive for several days or months on soils (Table 6-20).

No action means sludge would continue to be placed on sludge drying beds where it potentially could cause odors, attract vectors, and generate dust containing pathogenic organisms. Thence, dried sludge would be stockpiled at Montesa Park. A worst case scenario assumes there would be no drainage control, no concrete slab beneath the stockpile and no cover for protection from rain. Under these assumptions the following effects could occur:

- Runoff potentially could contaminate surface water with toxic elements, including: cadmium, arsenic, chromium, barium, zinc, lead, manganese and iron. These might or might not exist in quantities that would exceed the standards for safe drinking water quality.

- Bacteria (fecal coliform, streptococcal, and others), viruses (hepatitus) and parasites could be present in and near Montesa Park; however, quantities may or may not be harmful to human health

- There should not be any contaminated leachate entering groundwater because pollutants are filtered out in the soil before reaching the groundwater (300 feet below the surface at Montesa Park).

- Odor, dust, vectors and pathogenic aerosols may be problems associated with the stockpiles potentially could cause adverse health effects.

Table 6-20. Survival of selected pathogens on soils.

Organism	Range of Survival Time
Salmonella	15-280 days+
Salmonella typhis	1-120 days
Tubercle Bacilli	More than 180 days
Entamoeba histolytica cysts	6-8 days
Enteroviruses	8 days
Ascaris sp. ova.	Up to 7 years
Hookworm larva	42 days

Source: Parsons, et al. 1975.

Excess sludge not stockpiled at Montesa Park would be placed in lagoons probably north of and adjacent to the existing treatment plant. The lagoons would have to be lined to prevent leaching into the groundwater which is only five feet below the surface. Leachate containing significant amounts of nitrates could contaminate the drinking water supply of households in the area using wells. Additional effects potentially could include:

- aerosols containing pathogens
- odor causing nausea and headaches
- unsightly aesthetic quality
- mosquitoes and flies which could spread disease.

No action would result in sludge that is not disinfected nor disposed of in a manner which minimizes health effects. Many opportunities would exist for pathogenic organisms to contaminate the surrounding environment and possibly result in adverse health effects.

6.11.3 Environmental Consequences of the Action Alternatives

There are 11 options (i.e., treatment processes) in the action alternatives that potentially could have some impact on environmental health. These include: anaerobic digestion, transportation, solar greenhouse drying, open air drying, Cesium-137 irradiation, electron-beam irradiation, composting, stockpiling, landspreading on parks, landfilling, and dedicated land disposal. Potential environmental health effects from each of these processes are discussed in the following paragraphs.

- Anaerobic Digestion

Anaerobic digestion further removes moderate amounts of pathogenic organisms. It is speculated that anaerobic digestion causes nitrates to form ammonia, thereby reducing the concentration of nitrosamines (Rounbehler 1981). Therefore, this process has a beneficial effect due to the reduction or elimination of harmful organisms.

- Transportation

Fugitive dust and noise impacts from pipeline construction or truck transportation are anticipated. However, these impacts are not significant and are of short-term duration.

- Open Air Drying

Alternatives utilizing open air drying at Montesa Park will contain sludge that has not been disinfected. Significant odor problems and minor effects relating to vectors and dust containing pathogenic aerosols are expected. The open air drying area has a concrete base and concrete walls; therefore, there is no concern with groundwater contamination due to leaching. Surface runoff will be controlled, thus surface water contamination should not occur.

- Solar Greenhouse Drying

Since sludge will not be disinfected before drying, major odors from the exhaust air blown out at the back of the structure are anticipated, and also some dust containing pathogenic aerosols may be generated. It has been speculated that heat generated by the greenhouse process may also kill some of the pathogenic organisms, thereby rendering them harmless. Since the solar drying technology is relatively new, it has not yet been determined to what extent pathogenic organisms will be destroyed, if at all.

- Cesium-137 Irradiation

Cesium-137 is a radioactive nuclear by product which produces radiation. During normal operation it is expected that the workers at the plant (approximately 7 to 8 individuals) will be exposed to whole body gamma radiation of 0.05 rem/year. Although there is controversy surrounding the health impacts from low levels of radiation exposure, EPA supports the hypothesis that there are quantifiable health effects associated with low levels of radiation exposure. The major impact of radiation exposure less than 5 rems per year is radiogenic cancer. The risk of premature death from radiogenic cancer has been estimated using the absolute model and the relative risk model, the most conservative being the relative risk model. Using the relative risk model, the average lifetime risk of premature death for persons exposed occupationally to the same dose every year throughout their life between the ages of 18 to 65 was found to be approximately 0.01 per rem per year and proportional to dose over the range of 0 to 5 rem per year. The risk calculation using this figure would be conservative since it is unlikely that any worker would be exposed in each of his occupational years. At the proposed Albuquerque irradiator the workers are expected to be exposed to 0.05 rem per year; therefore, their lifetime risk of premature death from radiogenic cancer from these exposures would be:

$$0.01 \times \frac{0.05 \text{ rem}}{1 \text{ rem}} = 0.0005 = 0.05\% \text{ or less.}$$

In addition to this risk there is an approximately equal risk of developing a non-fatal radiogenic cancer (May 1981). A dose of 0.05 rem/year is 1% of the federal radiation occupational dose standard (10 CRF part 20.101) and the normal background radiation in Albuquerque is 0.15 to 0.2 rem/year for each person (ERDA 1977).

The Cesium-137 irradiator will be designed so that during normal operation the radiation exposure outside of the facility will not be detectable above background radiation within 3 to 10 feet of the facility. In the accident scenarios evaluated (Appendix 10.2) it is highly improbable that there would be a release of radioactive material. It is difficult to determine the exact impacts that would occur if radioactive material was released to the environment because the effects are dependent on the quantity released, pathway of exposure, dispersion potential and population distribution. However, if sufficient quantities of radioactive material were released to the environment the consequences would be severe. At this time there is insufficient evidence to determine the effect of irradiation on nitrosamines, which are known carcinogens. There is evidence that radiation will destroy those nitrosamines which remain after anaerobic digestion; however, if precursors of nitrosamines are available in the sludge, radiation may produce nitrosamines (by phone, David Rounbehler, New England Institute of Life Sciences, 14 July 1981).

Overexposure to personnel at the irradiator is a more likely occurrence of the accident scenarios, although the probability is still extremely low. In the event of overexposure, impacts to the personnel involved would be severe and in extreme cases would result in death. Unshielded exposure for a few seconds within 10 feet of the source plaque would result in almost instantaneous death (by phone, Neil Hartwigson, Sandia National Laboratory, 22 July 1981).

- Electron Beam Irradiation

Electron beam irradiation affords almost complete pathogen kill. Substantial pathogen reductions and viral destruction of have been achieved in liquid sludge with doses under 400 kilorads. Coliform levels under 10 coliforms per milliliter of sludge have been achieved with this process. Parasites, as well as their eggs, are totally destroyed by the electron beam radiation as they present relatively large targets. Electron beam irradiation is the only process evaluated that is able to destroy toxic organic substances present in sludge. The energy radiated by the beam produces hydroxyl compounds and sufficient activation energy to breakdown these compounds. Near total destruction of PCB's has been achieved in research to date.

High energy electrons bombarding surfaces do produce X-rays which require special shielding of the region within which deceleration of energized electrons takes place. The Albuquerque unit would require a 6 foot reinforced concrete wall around the central vault to contain the X-rays, and thereby protect workers from exposure. In order to prevent accidental exposure of workers to X-rays, a special interlocked door and electron beam arming system would be built into the design of the vault. Several types of safety systems provide redundancy in the system and thereby substantially eliminate chance of accidents.

- **Composting**

Composting is a disinfection process which results in extremely high temperatures that insure pathogen kill. Lethal temperatures occur at the core layers of compost pile, therefore it is important to turn the pile so that all layers of compost are exposed to this lethal range of temperatures. An important consideration of the composting process is the *Aspergillus fumigatus* fungus which is usually found in decomposing organic materials. This fungus is one of a few species of fungi that pose a pathogenic threat to man. Humans can effectively resist direct infection as *Aspergillus fumigatus* usually occurs as a secondary infection after the body tissue has been severely weakened by primary illness. Symptoms such as skin irritation, sneezing, congestion and difficult breathing are usually temporary and subside after the individual has been removed from the source of irritation. High concentrations of *Aspergillus fumigatus* can be anticipated around the sludge composting site; however, high spore levels are generally restricted to the immediate composting area and should not pose a threat to surrounding developments.

Any buffer zone provided around the composting site for odor control would aid in confining *Aspergillus fumigatus* aerosols to the compost processing areas. Concentrations of colonies of *Aspergillus fumigatus* in composted sludge have been shown to decrease to insignificant levels when the material is stockpiled for six months or more.

Groundwater pollution is not considered a potential problem because static compost piles at Montesa Park will rest on a 50 ft x 90 ft asphalt pad. However, leachate from composted sludge can contain heavy metals which are *not* removed by the composting process. High levels of cadmium, chromium and lead could render sludge unfit for use on food producing crops or pasture land. Potential effects of composting on the concentration of nitrosamines in sludge is presently undetermined (Rounbehler 1981).

- **Stockpiles of Disinfected Sludge to be Used as Fertilizer**

Stockpiles will contain disinfected sludge which may contain heavy metals. Therefore, leachate to groundwater is a potential problem since stockpiles typically are placed only on a bed of compacted earth. The groundwater is approximately 300 ft below the surface at Montesa Park, thus toxic elements will be filtered out in the soil before the groundwater is reached. However, this condition may not exist at each stockpile location selected in the City, thus stockpile operations should be conducted with caution. Stockpiles in all locations can be expected to release minor odors and dust, and potentially to attract mosquitoes and flies.

- Landspreading on City Parks and Golf Courses

Application of disinfected sludge as fertilizer will have very minor effects on the surrounding environment. There will be mild odors and dust generated for a few days after application. If the sludge system is managed properly there should not be any problems with groundwater leaching. However, if there is an oversupply of sludge applied in excessive quantities then there may be some potential for groundwater contamination (toxic elements), especially where the groundwater level is shallow (10' or less below the surface).

- Landfilling

Under proper management a landfill will not pose any significant threat to environmental or public health. A correctly designed landfill will have liners underneath the landfill, thereby preventing leaching into the groundwater. Each day after solid waste is placed in a landfill, it is covered with a layer of soil so as to prevent odors and insects. If runon (i.e., rainwater flowing across the ground toward the landfill) is diverted around the landfill, there should be no contamination of surface water. For public safety reasons access to the landfill should be restricted.

Under improper operation, the landfill site could have the following effects: significant odor, vectors, dust containing pathogenic aerosols, noise, contaminated groundwater from leachate, contaminated runoff to surface waters, and potential for explosions due to the buildup of methane gas. Each of these effects can occur due to improper landfill operation, even if sludge is not disposed at the landfill.

- **Dedicated Land Disposal**

Dedicated land disposal of liquid sludge that has not been disinfected potentially will have the following effects on environmental health:

- odor may be quite significant;
- mild noise confined to site vicinity;
- mosquitoes and flies attracted to site;
- liquid sludge containing pathogenic organisms can produce pathogenic aerosols;
- contaminated runoff containing toxic elements, organic compounds, and pathogens (both virus and bacterial) may contaminate surface waters if not properly collected and treated;
- potential for leaching into groundwater is very remote as the proposed sites at Pajarito and Rio Puerco are high above the groundwater level.

Sludge disposal through DLD can only occur until certain concentrations of nitrates, cadmium and PCB's are reached in the soil. EPA has established regulations (40 CFR 257) governing the concentration of cadmium and PCBs in the soil. There should not be any human contact with the sludge during operation of the DLD, and access to the site needs to be restricted. Should the site be sold at a later date, with the new owner desiring to grow crops, then the deed for sale needs to stipulate whether the concentration of cadmium and PCB's is within regulated standards.

Table 6-21 lists the effects that potentially will occur due to the construction and operation of each of the 14 action alternatives.

6.12 RECREATION AND AESTHETICS

6.12.1 Existing Conditions

There are no municipal, county, or state parks in the immediate vicinity of the treatment plant. The Albuquerque Raceway is located approximately 0.75 miles southeast of the plant. Several parks and a country club are located on the banks of the Rio Grande River in the general vicinity of

Table 6-21. Effects of alternatives for the Albuquerque sludge management system on environmental health.

	Wastewater Treatment Removal of:	Sludge Treatment Removal of:		Lagoons						Transportation of Sludge				Open Air Drying Beds			
	Small to moderate amounts of: Bacteria, Viruses, Protozoans, Helminths, Organic and inorganic compounds	Moderate amounts of pathogenic organisms from anaerobic digestion.	Organic/inorganic compounds	Leachate into groundwater	Aerosols containing pathogens	Odor	Poor aesthetic quality	Attract mosquitoes and insects	Contamination of nearby drinking water supply	Fugitive dust due to construction	Noise of pipeline	Noise from trucks	Dust/Emissions	Odor	Vectors	Dust/pathogenic aerosols	Attract mosquitoes + insects
No Action	○	○		●	●	●	○	●	●			○	○	●	●	●	●
1A	○	○										○	○				
1B	○	○								●	○						
1C	○											○	○	●	●	●	●
1D	○	○								●	○			●	●	●	●
1E	○	○										○	○				
1F	○	○								●	○						
1G	○	○										○	○	○	○		
1H	○	○								●	○			○	○		
2A	○	○										○	○				
2B	○	○										○	○				
3A	○	○										○	○				
3B	○	○								●	○						
3C	○	○									○						
3D	○	○										○	○				

	Solar Green-house		Composting				Cesium 137	Electron Beam	Stockpiles							
	Odor from exhaust air	Dust and aerosols with pathogenic organisms	High concentrations of A.Fumigatus.	Odor	Thoroughness of pathogen-kill.	Potential for contamination of groundwater with heavy metals.	Thoroughness of pathogen-kill	Thoroughness of pathogen-kill	Disinfected groundwater leachate	Disinfected runoff to surface water	Dust	Odors	Vectors	Runoff	Leachate	Pathogenic Aerosols.
No Action											●	●	●	●	●	●
1A	●	○					●		□	○	○	○	○			
1B	●	□					●		□	○	○	○	○			
1C							●		○	○	○	○	○			
1D							●		○	○	○	○	○			
1E			●	●	●	○			○	○	○	○	○			
1F			●	●	●	○			○	○	○	○	○			
1G								●	○	○	○	○	○			
1H								●	○	○	○	○	○			
2A											○	●	●			●
2B											○	●	●			●
3A																
3B																
3C																
3D																

	Landspread				Landfill								Dedicated land disposal						
	Odor	Disinfected Aerosols	Dust	Runoff with heavy metals.	Contaminated leachate to groundwater	Contaminated runoff to surface water	Odor	Dust	Vectors	Noise	Potential for explosions due to methane gas	Potential for contamination of nearby drinking water supply.	Contaminated leachate to groundwater	Contaminated runoff to surface water	Odor	Vectors	Pathogenic aerosols	Noise	Effect growth of crops in future time.
No Action																			
1A	○	○	○	○															
1B	○	○	○	○															
1C	○	○	○	○															
1D	○	○	○	○															
1E	○	○	○	○															
1F	○	○	○	○															
1G	○	○	○	○															
1H	○	○	○	○															
2A					○	○	●	●	○	○	○	○							
2B					○	○	●	●	○	○	○	○							
3A													●	●	○	○	○	○	○
3B													●	●	○	○	○	○	○
3C													●	●	○	○	○	○	○
3D													●	●	○	○	○	○	○

● - Major Effect
○ - Minor Effect

downtown Albuquerque, upstream of the plant. The Rio Grande River water quality is not suitable for contact recreation but is acceptable for non-contact recreation such as boating.

Montesa Park is not used as a recreation facility except for a gun club firing range. However, the surrounding area supports recreation in the form of hunting, shooting, and off-road vehicles. A soap box derby raceway is located just north of the area but appears to be abandoned or used infrequently. The New Mexico Timing Association Drag Strip is located just south of the area. A University of New Mexico Golf Course is located approximately one mile northwest of Montesa Park.

Both Rio Puerco and Pajarito are undeveloped areas. There are no people routinely in these areas nor are these areas known to support any recreation.

Prominent recreational facilities downstream of Albuquerque on the Rio Grande River are wildlife refuges, Elephant Butte Reservoir, and Caballo Reservoir. The wildlife refuges support wildlife observation and occasionally hunting. Both reservoirs support fishing, and water skiing is common on Elephant Butte Reservoir.

Aesthetics, in the form of visual appearance, is an environmental consideration in Albuquerque. Visual aesthetics and odor nuissance are project characteristics prominent in the public's mind, and likely to generate public concern in cases of noticeable degradation. However, visual degradation is only a concern when people are routinely in sight of the source or when the offense is located in an area particularly recognized for its visual aesthetic significance. Odor and noise are evaluated in Section 6.4 of this document.

6.12.2 Environmental Consequences of the No Action Alternative

Primary effects of the no action alternative on recreation will develop from the overloaded wastewater treatment plant and resulting decreased effluent quality. Effects of the discharge could be felt on the Rio Grande

River and may decrease water quality sufficiently to further reduce acceptable recreational uses of the river. Elephant Butte Reservoir and Caballo Reservoir could be affected similarly.

Other effects of no action are associated with aesthetic degradation by sludge lagoons north of the existing treatment plant facilities and potentially large sludge stockpiles at Montesa Park. The treatment plant is visible from the residential area just east of the facility. Depending on their exact location and design, the lagoons may generate opposition from residents based at least in part on visual appearance. Depending on their location, sludge stockpiles may be visible from Kirtland Air Force Base, Sandia Military Reservation, or the Albuquerque Police Department Prison and Farm.

6.12.3 Environmental Consequences of the Action Alternatives

Some people may feel that the presence of structures such as dewatering facilities, a solar greenhouse, open air drying beds, composting beds, or irradiation facilities at Montesa Park are aesthetically displeasing, especially if consideration is not given to appearance during the design and landscaping of the buildings. The greenhouse, for example, will be 60 ft tall. Open air drying beds will be shielded from view by 8-ft walls, but the walls themselves could be unattractive if visual aesthetics are not considered during design. The final stockpile at Montesa Park will be enclosed by a ten foot tall chain link fence which will not shield sludge from view. Small equalization piles, utilized before and after belt pressing will be open to view unless provisions are made for small storage piles in the dewatering building. Unless shielded, compost piles could be unattractive. Careful building design, layout, and landscaping at Montesa Park (possibly including wooded buffer zones) would significantly reduce aesthetic degradation of the area. Because Montesa Park is not a recreation facility, sludge management activities at that site would not hamper recreation.

Under the Group 1 alternatives, sludge will be applied to parks and golf courses one or two times per year. Access will not be restricted to the areas of application, thus odor may make their use undesirable for a short time if the sludge becomes wet. This condition, should it occur, is not likely to persist longer than 24 hours. Transportation of sludge to and from Montesa Park should not affect recreation or aesthetics other than the visual effect of trucks in the area.

If dewatering takes place at the treatment plant, as proposed for Group 2 alternatives, the addition of a belt press or filter press at Plant No. 2 will not significantly affect the overall appearance of the facility, and aesthetics will not be effected significantly. The landfill, while inherently displeasing aesthetically during operation, will not be altered significantly by the addition of sludge to the solid waste.

Dedicated land disposal sites are characterized by a large flat tract of land completely void of vegetation. Heavy equipment operates at the disposal site continuously. If the sites were visible from residences, businesses, recreation areas, or streets, they would be unattractive and aesthetically displeasing. However, Rio Puerco and Pajarito are remote from populated areas. Trucks to Rio Puerco do pass near residential areas, however. Recreation should not be affected by dedicated land disposal operations because little or no recreation takes place at or near either site.

6.13 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES AVAILABLE TO EPA

Issuing a grant for the proposed sludge management system or an alternative system will result in the City of Albuquerque meeting all applicable Federal regulations governing the disposal of wastewater sludges, potential elimination of increasing public concern regarding odors, and a reduction in numerous operation and maintenance problems presently encountered with the sludge management process equipment. Substantial economic, material, manpower, and energy resources will be assigned to the project, representing an irreversible commitment of resources to a sludge management system for the Albuquerque area. Short-term economic benefit will consist of construction employment opportunities and secondary economic stimulation; however, some of the economic benefit may be realized outside the Albuquerque area. Adverse short-term effects include noise, dust, and traffic disruption because of construction, but these will be controlled within tolerable limits.

Denial of a grant will constitute EPA taking the "no action" alternative. EPA should decide not to fund any sludge management system, the overall advisability of expanding the Albuquerque wastewaste collection system and the liquid treatment units at Plant No. 2 would have to be reevaluated. The exact situation that would exist if EPA chose the no action alternative would depend on: (1) what portions (if any) of the proposed treatment units at Plant No. 2 (other than sludge management) EPA would continue to fund, and (2) what action the City of Albuquerque would take in response to an EPA decision to not provide grant funds for any sludge management program.

If the City chose to construct one of the 14 action alternatives previously described using only City and State funds, then the effects of that action would be as described in Chapter 6.0 of this EIS for the particular action alternative chosen. If the City chose to take no action as a result of EPA's denial of the grant, then the resulting effects would be as described in Section 5.2 of this document.

6.14 ENVIRONMENTAL CONSEQUENCES OF ALTERNATIVES AVAILABLE TO OTHER AGENCIES

If another agency denies a permit or certification necessary for the operation of the system, and the City of Albuquerque is unable to comply with restrictions placed on the system by that agency, the project will not be implemented, resulting in effects similar to those under no action. If all necessary permits and approvals are issued, effects will be similar to those associated with the approved project alternative, as discussed previously for each discipline (Sections 6.1 through 6.12).

6.15 MITIGATIVE MEASURES

The following principal mitigative measures potentially can reduce or eliminate any potential impacts that could occur from implementation of any of the 14 alternatives previously discussed in Chapter 6.0. Most of the mitigative measures listed below are presently being considered for implementation by the grant applicant (City of Albuquerque) and/or EPA.

- Minimization of Construction Impacts

Construction activities could cause significant impacts. These impacts would be associated primarily with the construction of the new pipeline and the construction of the sludge processing facilities. Adverse impacts, however, can be controlled, and most should be of short duration.

Fugitive dust at the construction sites (pipeline routes and Montesa Park) can be reduced by the use of several techniques. Construction sites, spoil piles, and unpaved access roads can be wetted periodically to minimize dust. Spoil piles also can be covered with matting, mulch, and other materials to reduce susceptibility to wind erosion. Street sweeping at access sites would control loose dirt that could be "tracked" onto roadways by construction equipment. Trucks that haul spoil from excavation and trenching sites should have covers on their loads to eliminate the escape of dust while in transit to the disposal sites.

Proper maintenance of construction equipment would minimize emissions of hydrocarbons and other fumes. Air pollution control devices also could be used on stationary internal combustion engines.

Where land would be disturbed and soils exposed, measures must be taken to minimize erosion. In Program Requirements Memorandum 78-1, EPA established requirements for the control of erosion and runoff from construction activities. Adherence to these requirements would minimize the potential for problems. The requirements include:

- The project plan and layout should be designed to fit the local topography and soil conditions;

- When appropriate, land grading and excavating should be kept at a minimum to reduce the possibility of creating runoff and erosion problems that would require the application of extensive control measures;

- Whenever possible, topsoil should be removed and stockpiled before grading begins;

- Soil exposure should be minimized in terms of area and time;

- Exposed areas subject to erosion should be covered as quickly as possible by means of mulching or vegetation;

- Natural vegetation should be retained whenever feasible;

- Appropriate structural or agricultural practices to control runoff and sedimentation should be provided during and after construction;

- A stabilized drainage system (temporary and permanent systems) should be completed as early as possible to reduce the potential for erosion;

- Access roadways should be paved or otherwise stabilized as soon as feasible;

- Clearing and grading should not be started until a firm construction schedule is known and can be coordinated effectively with the grading and clearing activity.

Appropriate planning could control construction-related disruption in the community. Announcements should be published in newspapers and broadcast through other news media to alert drivers of temporary closings of primary traffic routes during construction of the sludge management system force mains. Traffic control may be needed at points where certain construction equipment would enter into public streets from access areas. Special care should be taken to minimize disruption of access to commercial establishments and to frequently visited areas. Planning of routes for heavy construction equipment should include consideration of surface load restrictions to prevent damage to streets and roadways.

- Runoff Control

There are two sources of runoff. One is the liquid in the sludge and the other is precipitation falling on a sludge application site. Runoff control consists of containment and/or treatment of liquid from the site to prevent degradation of nearby surface streams. Runoff from adjacent properties should be diverted around the application site. On-site containment of liquid from sludges or precipitation is normally provided by small impoundments placed at needed locations on the site. The contained liquids can be recycled for further treatment, can be reduced through evaporation, or can be discharged after sufficient detention time.

- Storage

Storage is critical for time periods when application operations are not possible. These time periods may be several weeks due to severe cold weather conditions or they may be several days due to excessive precipitation. Storage is usually provided by lagoons for liquid sludge or stockpiles for solid sludge. Storage systems must be adequately sized and designed to minimize the possibility of nuisance conditions. The storage requirements will vary somewhat depending on application method.

- Drainage or Leachate Control

Storage lagoons should be lined in areas where groundwater supplies are threatened, if the dedicated land disposal method is utilized. More positive control can be provided by drainage ditches placed on the outside of berms around the lagoons. If lining is inadequate, and groundwater levels are high, the leachate may be captured by ditches for appropriate treatment.

- Odor Control

Odor control is best achieved by adequate stabilization before storage. Odor control of partially stabilized sludge is extremely difficult. High dosages of chlorine or lime may help temporarily but may not be allowed by regulatory authorities. The best control method is backup stabilization processes and proper operation of stabilization systems. Additional control equipment such as scrubbers and electrostatic precipitators could be utilized on exhaust gas vents to remove odors and excessive particulates Odor masking systems often are not effective or publically acceptable.

CHAPTER 7.0

COORDINATION

7.0 COORDINATION

7.1 SCOPING MEETING

Early in the EIS process, EPA held a public scoping meeting at the City Hall in Albuquerque, New Mexico (7:30 pm on 7 October 1980). The purpose of this meeting was to receive input from the public as to what issues should be included within the scope of the supplemental Environmental Impact Statement to be prepared in conjunction with the City of Albuquerque's wastewater treatment facilities plan amendment. Major concerns raised at the meeting included the following: reviewing agencies for the Supplemental EIS, mailing list, land use, effect on land values, wilderness area, water quality, water resources, 100-year flood plain, drainage patterns, endangered species, odor, air quality sampling, need for expansion of waste treatment facilities, use of sludge to grow energy crops, alternatives to irradiation, transportation of radioactive material, potential health effects from the irradiator, legal stipulations, archeology, and reconsidering the 1977 EIS. EPA's responses to these issues are listed in a responsiveness summary located at public information depositories in the City of Albuquerque (see Section 7.2).

7.2 PUBLIC PARTICIPATION ACTIVITIES

Public participation activities were an integral component of the preparation of the Albuquerque Wastewater Treatment Facilities Supplemental EIS, and consisted of three basic elements: (1) public meetings, (2) Citizen Advisory Committee (CAC) meetings and activities, and (3) EIS information releases.

In addition to the scoping meeting held by EPA on 7 October 1980, another public meeting was held by the City of Albuquerque on 8 July 1981 to inform the public of progress on the supplemental EIS and to discuss preliminary and optimal alternatives. Major concerns expressed at this meeting included odor, disinfection alternatives, irradiator safety, potential effects of heavy metals in the sludge, EPA funding, closing of plant No. 1, the appointment of persons to the CAC, methane gas production, current use of sludge, quality of effluent from wastewater treatment plant No. 2, and optimal recommendations. Responses to these comments/questions also are included in a responsiveness summary located at the public information depositories. A Public Hearing is scheduled to be held on 11 November 1981 to discuss this Draft Supplemental EIS.

Public information depositories also were established for the purpose of maintaining public awareness of ongoing EIS activities. These depositories were established at the following six (6) locations: Albuquerque Public Library-Main Branch, Prospect Park Branch Library, Zimmerman Library, Esperanza Branch Public Library, Los Griegos Branch Public Library, and Wastewater Treatment Plant No. 2. Table 7-1 lists the material that currently is, or will be located at these depositories.

A Citizen Advisory Committee (CAC) was established to provide input to the City of Albuquerque concerning sludge management alternatives. The committee is composed of 15 members with equal representation in the following four categories: private citizens, public interest groups, public officials, and persons with substantial economic interests. The CAC members appointed by the City for the Albuquerque public participation program and their respective classification are listed in Table 7-2.

CAC meetings were open to the public and time was provided at each meeting for the public to ask questions and express ideas. Minutes prepared for each meeting are available at the public information depositories.

The CAC selected independent consultants to review reports and present expert testimony concerning certain subjects where the CAC desired more specific information. J. C. Robertson, a nuclear engineering professor at the University of New Mexico discussed the irradiation disinfection alternatives. Mr. Robertson concluded that the City could operate a Cesium-137 gamma irradiation facility, but made several recommendations including having DOE responsible for decontamination activities in case of an accident.

Table 7-1. Information located at the public information depositories.

- Final Environmental Impact Statement 1977
- Albuquerque Areawide Wastewater Collection and Treatment Facilities Plan - October 1978
- Preliminary Value Engineering Report by Arthur Beard - February 1980
- Summary Value Engineering Report by Camp Dresser & McKee - May 1980
- Final Phase II Expansion Report by Camp Dresser & McKee - December 1980
- Activated Sludge Operational Analysis by AWARE - July 1978
- Public Participation Regulations (40 CFR Parts 25, 35)
- Municipal Wastewater Treatment Works, Construction Grants Program - 27 September 1978
- CEQ Regulations (40 CFR Parts 1500-1508)
- Nuclear Regulatory Commission Regulations (10 CFR Parts 2, 20, 30, and 71)
- Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)
- "A Guide to Regulations and Guidance for the Utilization and Disposal of Municipal Sludge" (430/9-80-015)
- "A Primer on Wastewater Treatment" - Office of Public Affairs (A-107)
- Responsiveness Summaries to Public Meetings
- EPA Notice of Intent to prepare an EIS
- Public Participation Workplan
- EPA Directive of Work to WAPORA
- WAPORA's Final Scope of Work
- Transcript of Public Scoping Meeting
- Minutes of CAC Meetings (when available)
- Draft Supplemental EIS (when available)
- Transcript of Public Hearing (when available)
- Final Supplemental EIS (when available)
- Record of Decision (when available)

Table 7-2. Members of the City of Albuquerque sludge management system Citizen Advisory Committee (CAC).

MEMBER	CATEGORY
Kay Grotbeck	Public Interest
Gene Martinez	Public Interest
Stan Read	Public Interest
Freddie Ward	Public Interest
Fred Seebinger	Public Official
Jay Sorenson	Public Official
Wiley Smith	Public Official
Rosa Grado	Private Citizen
Evelyn Oden	Private Citizen
Douglas Smith	Private Citizen
Stephen Verchinski	Private Citizen
Herb Denish	Economic Interest
Ivan Rose	Economic Interest
Walter Webster	Economic Interest
Jim Wiegmann	Economic Interest

Dr. Norman E. Kowal, Ph.D., M.D. discussed health effects of land application of disinfected sludge. He compared gamma irradiation and composting for pathogen kill, salmonella regrowth, odor, and other areas specific to each process. He concluded that gamma irradiation would be the soundest choice for sludge disinfection.

During the review period of this Draft Supplemental EIS the CAC will formulate recommendations on the sludge management alternatives. The CAC recommendations will be presented to the City, and potentially will be made known to the public at the Public Hearing scheduled for November 1981.

7.3 COOPERATING AGENCIES

EPA contacted two Federal agencies, the Department of Energy and the Soil Conservation Service, requesting that they participate in the preparation of the Supplemental Environmental Impact Statement for the proposed sludge management system for the City of Albuquerque. Both agencies agreed to participate and provide technical assistance to EPA.

7.4 ACKNOWLEDGMENTS AND LIST OF PREPARERS

Much of the information for this environmental impact statement was obtained from the City of Albuquerque Water Resources Department and its consultants, Camp Dresser and McKee, Inc., and Wilson and Company. Sandia National Laboratories and DOE provided valuable information concerning the utilization of Cesium-137 as a radiation source to disinfect sludge. Appreciation is expressed to these groups for information provided.

This environmental impact statement was prepared by WAPORA, Inc., for the US Environmental Protection Agency, Region 6, under the guidance of the EPA Project Officer, Mr. Clinton Spotts; the Project Monitor, Mr. Norman

Thomas; and EIS preparation section staff member, Ms. Darlene Owsley. Key input was also provided by Mr. Larry Brnicky, EPA Construction Grants Project Engineer, and by Ms. Rosemary Henderson, EPA Public Participation Specialist. Key personnel for WAPORA included:

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Dawn Davenport-Johnson, M.S.	Environmental Scientist/Public Participation Coordinator
Nowzar Dinyarian, M.S.	Assistant Project Manager/ Environmental Engineer
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Roy E. Greer, M.S.	Senior Ecologist
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Mary Lou Motl, M.S.	Editor
James C. Varnell, P.E.	Project Manager
D. Keith Whitenight, M.F.	Project Administrator
Priede Sedgewick, Inc.	Subcontractor/Consultants

7.5 MAILING LIST FOR ENVIRONMENTAL IMPACT STATEMENT

Listed on the following page(s) are governmental agencies and public interest groups which will receive a copy of the Supplemental EIS. In additional, about 300 other groups and individuals were notified in August 1981 of the Supplemental EIS's upcoming publication. Many of these individuals also will receive a copy of the Supplemental EIS.

MAILING LIST FOR THE SEIS ON THE PROPOSED CITY OF ALBUQUERQUE SLUDGE MANAGEMENT SYSTEM

Federal Agencies

Advisory Council on Historic Preservation
Kirtland AFB
Representative Manuel Lujan
Senator Harrison J. Schmitt
Senator Pete Dominica
US Army Corps of Engineers
US Department of Agriculture (USDA)
USDA Agricultural Stabilization and Conservation Service
USDA Farmer's Home Administration
USDA Forest Service, Cibola National Forest
USDA Soil Conservation Service
US Department of Commerce (USDOC)
USDOC Economic Development Administration
US Department of Energy
US Department of Health and Human Services
US Department of Interior (USDOI)
USDOI Bureau of Indian Affairs
USDOI Bureau of Land Management
USDOI Fish and Wildlife Service
USDOI National Park Service
USDOI US Geological Survey
US Public Health Service
US Department of Transportation (USDOT)
USDOT Federal Aviation Administration
USDOT Federal Highway Administration
Water Resources Council

State Agencies

Department of Agriculture
Department of Game and Fish
Environmental Improvement Division
Parks and Recreation Commission
State Engineers Office
State Historic Preservation Officer
State Land Office
State Planning Office

MAILING LIST FOR THE SEIS ON THE PROPOSED CITY OF ALBUQUERQUE SLUDGE MANAGEMENT SYSTEM (concluded)

Public Interest Groups

Audubon Society
Citizen Against Nuclear Threat
Citizens for Alternatives to Radioactive Dumping
Conservation Action League
Izaak Walton League
Keep New Mexico Beautiful
League of Women Voters
New Mexico Citizens for Clean Air and Water
New Mexico Conservation Coordinating Council
New Mexico Lung Association
New Mexico Wildlife Federation
Sierra Club
Southwest Research and Information Center
Southwest Valley Area Council
The Nature Conservancy
Trout Unlimited

CHAPTER 8.0

BIBLIOGRAPHY

8.0 BIBLIOGRAPHY

Advisory Council on Historic Preservation. Procedures for the protection of historic and cultural properties. 36 CFR Part 800

Albuquerque/Bernalillo County Planning Department. 1977. City of Albuquerque zone atlas. Albuquerque NM, variously paged.

Albuquerque/Bernalillo County Planning Department. 1978. Population forecasts by data analysis sub-zones. Albuquerque NM, 26 p.

Albuquerque/Bernalillo County Planning Department. 1979. Population forecasts by data analysis sub-zones. Albuquerque NM, 29 p.

Albuquerque Environmental Health Group, Air Pollution Control Division. 1973. Air pollution control regulations. Albuquerque NM, 56 p.

Arthur Beard Engineers, Inc. 1980. Southside Wastewater Reclamation Plant No. 2, The City of Albuquerque, New Mexico, preliminary value engineering report study A. Phoenix AZ, variously paged.

Associated Water and Air Resources Engineers, Inc. 1978a. Activated sludge operational analysis engineering report. Prepared for City of Albuquerque, New Mexico. Houston TX, variously paged.

Associated Water and Air Resources Engineers, Inc. 1978b. Activated sludge operational analysis executive summary. Prepared for City of Albuquerque, New Mexico. Houston TX, variously paged.

Associated Water and Air Resources Engineers, Inc. 1978c. Activated sludge operational analysis appendix. Prepared for City of Albuquerque, New Mexico. Houston TX, variously paged.

Ayanaba, A., and M. Alexander. 1973. Microbial formation of nitrosamines in vitro. Applied Microbiology, variously paged.

Ayanaba, A., and M. Alexander. 1974. Transformation of methylamines and formation of a hazardous product, demethylinitrosamines in samples of treated sludge and lake water. Journal of Environmental Quality. Variously paged.

Baldwin, J.L. 1973. Climates of the US. US Department of Commerce. Washington DC, 113 p.

Bank of New Mexico, and University of New Mexico, Bureau of Business and Economic Research. 1980. 18th annual summary study. The economy of the State of New Mexico and the Albuquerque SMSA. Albuquerque NM, 50 p.

Banks, K.M. 1981. Cultural resource inventory of the proposed Montesa Park sludge treatment and storage facility, and the Tijeras Arroyo Pipeline, Albuquerque, New Mexico. Report submitted by WAPORA, Inc. to US Environmental Protection Agency, Region 6, Dallas TX, variously paged.

Beck, W.A., and Y.D. Haase. 1969. Historical atlas of New Mexico. University of Oklahoma. Norman OK, variously paged.

Bernalillo County Environmental Health Personnel. 1980. Nitrate as nitrogen, groundwater quality report of the Mountainville community. Albuquerque NM, 25 p.

Bjorklund, L.J., and B.W. Maxwell. 1961. Availability of groundwater in the Albuquerque area, Bernalillo and Sandoval Counties, New Mexico. Technical Report 21. New Mexico State Engineer. Santa Fe NM, 117 p.

Brannen, J.P., D.M. Garst, and S. Langley. 1975. Inactivation of Ascaris lumbricoides eggs by heat, radiation, and thermoradiation. Sandia Laboratories. Albuquerque NM, 26 p.

Brown, V. 1981. Phone, Vinson Brown, City of Albuquerque, 13 July 1981.

Bruce, S. 1981. Phone, Sherlie Bruce, US Environmental Protection Agency, Dallas TX, 5 June 1981.

Camp Dresser & McKee, Inc. 1977. Sludge handling, noise reduction and odor control part I study and report. Prepared for City of Albuquerque, New Mexico Water Resources Department. Denver CO, variously paged.

Camp Dresser & McKee Inc. 1977. Plant operations and maintenance, sludge handling and odor control management and staff part II study and report. Prepared for City of Albuquerque, New Mexico Water Resources Department. Denver CO, variously paged.

Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980a. Advance copy of draft final (extract) southside wastewater treatment plant phase II expansion program engineering report. Prepared for City of Albuquerque (New Mexico) Water Resources Department, Engineering Division. Albuquerque NM, variously paged.

Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980b. City of Albuquerque, New Mexico southside wastewater treatment plant phase II expansion program engineering report. Prepared for City of Albuquerque, New Mexico Water Resources Department. Albuquerque NM, variously paged.

Camp Dresser & McKee, Inc., and William Matotan & Associates, Inc. 1980c. Southside wastewater reclamation plant no. 2 phase II expansion program summary value engineering report study A (report stage). Prepared for City of Albuquerque, New Mexico Water Resources Department. Albuquerque NM, 40 p.

Camp Dresser & McKee, Inc., and Wilson and Company Engineers and Architects. 1981. Notes on updated costs for City of Albuquerque in wastewater treatment facilities solids management system alternatives. Albuquerque NM, variously paged.

Campbell, J.M., and F.H. Ellis. 1952. The Atrisco Sites: Cochise manifestation in the Middle Rio Grande Valley. American Antiquity 17 (3):211-221.

Carpenter, P.L. 1977. Microbiology. W.B. Saunders Company. Philadelphia PA, 512 p.

CH$_2$M Hill. 1980a. Generic environmental assessment of sludge irradiation. Albuquerque NM, variously paged.

CH$_2$M Hill. 1980b. Irradiation of sewage sludge using Cesium-137: a comparative assessment. Albuquerque NM, variously paged.

Chamber of Commerce. 1979. Large employers in the Albuquerque area. Albuquerque NM, 18 p.

Chamber of Commerce, Albuquerque, New Mexico. 1980a. Population estimates and projections. Albuquerque SMSA fact sheet 1980. Albuquerque NM, variously paged.

Chamber of Commerce, Albuquerque, New Mexico. 1980b. Fact sheets--income employment, population, labor, and economy. Albuquerque NM, variously paged.

Cheremisinoff, P.N., and R.A. Young (Eds.). 1975. Industrial odor technology assessment. Ann Arbor Science Publishers Inc. Ann Arbor MI, 509 p.

City of Albuquerque. No date. Albuquerque/Bernalillo County comprehensive plan--a summary report. Albuquerque NM, variously paged.

City of Albuquerque. 1979a. Budget of the mayor. FY 1979/80. Albuquerque NM, 239 p.

City of Albuquerque. 1979b. Capital improvements program 1979-1981. Albuquerque NM, 22 p.

City of Albuquerque. 1980a. Budget of the major. FY 1980/81. Albuquerque NM, variously paged.

City of Albuquerque. 1980b. Capital implementation program. Capital status report as of September 30, 1980. Albuquerque NM, 25 p.

Cordell, L.S. 1979. A cultural resource overview of the Middle Rio Grande Valley, New Mexico. US Government Printing Office. Washington DC, variously paged.

Cordell, L.S. (Ed.). 1980. Tijeras Canyon: analyses of the past. Maxwell Museum of Antropology and the University of New Mexico Press. Albuquerque NM, variously paged.

Cornell University, New York State College of Agriculture and Life Sciences. 1976. Land application of wastes: an educational program. New York NY, variously paged.

Council on Environmental Quality. 1978. Final regulations for implementation of the procedural provisions of the National Environmental Policy Act. 40 CFR Chapter V, Parts 1500-1508.

Crites, S. 1979. An approach for comparing health risks of wastewater treatment alternatives. US Environmental Protection Agency, Office of Water Program Operations, 66 p.

Duran, Dave. 1981. Letter, Dave Duran, NM-EID, to Dawn Davenport-Johnson, WAPORA, Inc., 13 May 1981, 3 p.

Energy Research and Development Administration (ERDA). 1977. Environmental impact assessment: Sandia Laboratories. EIA/MA 77-1. Albuquerque NM, variously paged.

Ehlers, V., and E. Steel. 1965. Municipal and rural sanitation. McGraw-Hill Book Company. New York NY, 663 p.

Fisher, R. G. 1931. Second report of the archaeological survey of the Pueblo Plateau: Santa Fe sub-quadrangle A. The University of New Mexico Bulletin Survey Series, Vol. 1, No. 1, variously paged.

Free, Bob. 1981. Letter, Bob Free, Texas Department of Health, to Dawn Davenport-Johnson, WAPORA, Inc., 6 July 1981.

Hibben, F.C. 1951. Sites of the Paleo-Indians in the Middle Rio Grande Valley. American Antiquity 17(1):41-46.

Holzworth, G.C. 1972. Mixing heights, wind speeds and potential for urban air pollution throughout the contiguous US. US Environmental Protection Agency, Research Triangle Park NC, 117 p.

Hosler, C.R. 1961. Low level inversions. Monthly Weather Review 89:319-339.

Illinois University. 1981. Helminth and heavy metals transmission from anaerobically digested sewage sludge. Prepared for US Environmental Protection Agency, Municipal Environmental Research Laboratory. Cincinnati OH, 56 p.

Industrial Development Service, Inc. 1980. Digest of major new industries located in Albuquerque. Fact Sheet. Albuquerque NM, variously paged.

Jenkins, T.F., S.T. Quarry, I.K. Iskanoar, A.D. Edwards, and H.E. Hare. 1979. Use of ^{15}N to study nitrogen transformations in land treatment. United States Army Corps of Engineers. Hanover NH, 26 p.

Judge, W.J. 1973. Paleoindian occupation of the Central Rio Grande Valley in New Mexico. University of New Mexico Press Albuquerque NM, variously paged.

Khera, A.K. 1981. Letter, Ashok Khera, Water Resource Department, to James C. Varnell, WAPORA, Inc., City of Albuquerque, 20 July 1981.

Kowal, N.E. 1981. Letter, Norman E. Kowal, Research Medical Officer/ USEPA, to Paul D. Noland, City of Albuquerque/Water Resources Department, 24 July 1981.

McMullen, W.H. 1981. Letter, William McMullen, Department of Energy, to Darlene Owsley, US Environmental Protection Agency, Region 6, 7 July 1981.

Mason, B. and L.G. Berry. 1958. Elements of mineralogy. San Francisco CA, 550 p.

Massachusetts Institute of Technology. 1980. Estimated capital and operating costs for sludge disinfection process system. Cambridge MA, 3 p.

May, H.D. 1981. Letter, Hank May, US Environmental Protection Agency, - Region 6 Radiation Representative, to Dawn Davenport-Johnson, WAPORA, Inc., 24 July 1981.

Middle Rio Grande Council of Governments of New Mexico. 1979a. Areawide comprehensive planning guide for land use decisions. Albuquerque NM, 71 p.

Middle Rio Grande Council of Governments of New Mexico. 1979b. Greater Albuquerque area 1995 socioeconomic forecasts. Small area allocations (1979 reevaluation). Albuquerque NM, 16 p.

Middle Rio Grande Council of Governments of New Mexico. 1979c. 1979 Traffic flow for the greater Albuquerque area. Albuquerque NM, 1 sheet.

Middle Rio Grande Council of Governments of New Mexico. 1980. Socioeconomic indicators 1977 estimates. Albuquerque NM, variously paged.

Middle Rio Grande Council of Governments of New Mexico. 1981. Long range major street plan, Albuquerque urban area. Albuquerque NM, 1 sheet.

Molzen Corbin & Associates. 1978. Design criteria for dry sludge irradiation demonstration plant (DISIDP). Prepared for Sandia Laboratories. Albuquerque NM, 83 p.

Morris, M.E., J.S. Sivinski, J.R. Brandon, K.S. Newhauser and R.L. Ward. 1979. A summary of recent development in the sludge irradiation program at Sandia Laboratories. Sandia Laboratories. Albuquerque NM, 57 p.

Morris, M.E. 1980. Sandia irradiator for dried sewage solids final safety analysis report. Sandia National Laboratories. Albuquerque NM, 132 p.

National Academy of Sciences. 1977. Analytical studies for the US Environmental Protection Agency, volume IX, multimedium management of municipal sludge. National Research Council. Washington DC, 201 p.

New Mexico Employment Security Department. 1980. New Mexico labor market review. Volume 9. Numbers 11 and 12, variously paged.

New Mexico Health and Social Services Department. 1976. Assessment of the impacts of Albuquerque wastewater on the trophic status of Elephant Butte Reservoir. Albuquerque NM, variously paged.

New Mexico State University. Reports on the effectiveness and safety of irradiated sludge as a soil conditioner/fertilizer and animal feed supplement.

New Mexico Water Quality Control Commission. 1976. Middle Rio Grande Basin plan. Santa Fe NM, 107 p.

New Mexico Water Quality Control Commission. 1979a. New Mexico statewide water quality management plan. Santa Fe NM, 107 p.

New Mexico Water Quality Control Commission. 1979b. New Mexico statewide water quality management plan--appendix. Santa Fe NM, variously paged.

New Mexico Water Quality Control Commission. 1980. State of New Mexico water quality status summary. Santa Fe NM, 69 p.

Pahren, H., and W. Jakubouiski (Eds.). 1980. Wastewater aerosols and disease: proceedings of a symposium. US Environmental Protection Agency. EPA-600/9-80-028. Cincinnati OH, 367 p.

Pahren, H., et al. 1979. Health risks associated with land application of municipal sludge. Journal Water Pollution Control Federation 51(11): 2588-2599.

Patterson, C.C. 1970. An analysis of the impact of the wastewater effluent on the City of Albuquerque on the water quality of the Rio Grande, New Mexico, 17 December.

PEER Consultants, Inc. 1980. Production of non-food-chain crops with sewage sludge. Prepared for US Environmental Protection Agency, Municipal Environmental Research Laboratory. Cincinnati OH, 95 p.

Perkins, H.C. 1974. Air pollution. McGraw-Hill Book Company. New York NY, 407 p.

Priede-Sedgwick, Inc. 1981. Letter, Stephen R. Sedgwick, Priede-Sedgwick, Inc., to James C. Varnell, WAPORA, Inc., 2 July 1981.

Priede-Sedgwick, Inc. 1981. Letter, Stephen R. Sedgwick, Priede-Sedgwick, Inc., to James C. Varnell, WAPORA, Inc., 7 July 1981.

Reeder, H.O., L.J. Bjorklund, and G.A. Dinwiddie. 1967. Quantitative analysis of water resources in the Albuquerque area, New Mexico. Technical Report 33. New Mexico State Engineer. Santa Fe NM, 34 p.

Reinhart, T.R. 1967a. The Alameda Phase: an early basketmaker III culture in the Middle Rio Grande Valley, New Mexico. Southwestern Lore 33(1):24-32.

Reinhart, T.R. 1967b. The Rio Rancho Phase: a preliminary report on early basketmaker culture in the Middle Rio Grande, New Mexico. American Antiquity 32(4):458-470.

Reinhart, T.R. 1968. Late Archaic cultures of the Middle Rio Grande Valley, New Mexico: a study of the process of cultural change. Ph.D. dissertation, University of New Mexico. Albuquerque NM, variously paged.

Reynold, S.E., J.C. Yates, and P.D. Akin, 1976. Coordinated administration of surface and ground water under the doctrine of prior application, Washington DC. May 23-31.

Rogers, J.B. 1980. West Mesa Airport archaeological survey report. Report submitted by the Center for Anthropological Studies to Chambers, Campbell, Isaacson, Chaplin, Inc. Variously paged.

Rogers, J.B. 1981. An archaeological synthesis of the Tijeras Arroyo portion of Bernalillo County, New Mexico. Report submitted by the Center for Anthropological Studies to WAPORA, Inc.

Sales and Marketing Management. 1980. Survey of buying power, part 1. New York NY, variously paged.

Sandia Laboratories. 1979. Progress report beneficial uses program period ending March 31, 1979. Albuquerque NM, 58 p.

Sandia Laboratories. 1979. Progress report beneficial uses program period ending June 30, 1979. Albuquerque NM, 51 p.

Sandia Laboratories. 1979. Sandia irradiator for dried sewage solids seminar proceedings and dedication October 18-19, 1978 Albuquerque, New Mexico. Albuquerque NM, 192 p.

Sandia National Laboratories. 1980. National symposium on the use of Cesium-137 to process sludge for further reduction of pathogens report. SAND 80-2744. Denver CO.

Sandia National Laboratories. 1980. National symposium on the use of Cesium-137 to process sludge for further reduction of pathogens, September 3-4, 1980, Denver, Colorado. Albuquerque NM, 361 p.

Sandia National Laboratories. 1980. Progress report beneficial uses program period ending September 30, 1979. Albuquerque NM, 71 p.

Sandia National Laboratories. 1980. Progress report beneficial uses program period ending December 31, 1979. Albuquerque NM, 66 p.

Soil Conservation Service. 1977. Soil survey of Bernalillo County and parts of Sandoval and Valencia Counties, New Mexico. US Department of Agriculture. Washington DC, 101 p.

Stier, P. 1981. Phone, Pat Stier, Bohannan & Huston, Inc., Albuquerque NM, 19 July.

Stone, R. and J. Rowlands. 1980. Long-term effects of land application of domestic wastewater, Mesa, Arizona: irrigation site. US Environmental Protection Agency. Robert S. Kerr Environmental Research Laboratory. Ada OK, 247 p.

Summer, W. 1971. Odor pollution of air: causes and control. CRC Press, Cleveland OH, 310 p.

Tainter, J.A. and D.A. Gillio. 1980. Cultural resource overview: Mt. Taylor area, New Mexico. US Department of Agriculture, Forest Service, Southwest Region, and Bureau of Land Management, New Mexico State Office. Variously paged.

Task Force on Odor Control. 1979. Odor control for wastewater facilities, Manual of Practice No. 22, Lancaster Press, Inc., Lancaster PA, 80 p.

Thomas, R.E. and T.W. Bendixen. 1969. Degradation of wastewater organics in soil. Journal Wwater Pollution Control Federation 41(5), Part I, variously paged.

Turk, A., S.W. Johnston and D.G. Moulton (Eds.). 1974. Human responses to environmental odors. Academic Press. New York NY, 345 p.

US Department of Agriculture. 1980. Important farmlands, Bernalillo County, New Mexico. Soil Conservation Service, Albuquerque NM, 1 sheet.

US Department of Commerce. 1960. Protection against radiations from sealed gamma sources: handbook 73. National Bureau of Standards. Washington DC, 70 p.

US Department of Commerce. 1978. Local climatological data/Dallas-Fort Worth, Texas. National Oceanic and Atmospheric Administration. Asheville NC, 4 p.

US Department of Commerce. 1981a. 1980 census of population and housing, advance reports--New Mexico--final population and housing unit counts. Bureau of Census. Washington DC, 10 p.

US Department of Commerce. 1981b. 1980 census of population and housing, preliminary reports. Bureau of Census. Washington DC, 6 p.

US Department of Energy - Sandia Laboratories--Research reports on pilot sludge irradiation facilities.

US Department of Health, Education and Welfare, Public Health Service. 1980. Health hazard evaluation determination report. HE 79-28-674. Variously paged.

US Department of Transportation. 1973. Fundamentals and Abatement of Highway Traffic Noise. Federal Highway Administration. Washington DC, variously paged.

US Environmental Protection Agency. 1973a. Health and annoyance impact of odor pollution. EPA-650/1-75-001. Washington DC, variously paged.

US Environmental Protection Agency. 1973b. Odors emitted from raw and digested sewage sludge. EPA-670/2-73-098. Washington DC, variously paged.

US Environmental Protection Agency. 1975. Final regulations for navigable waters: selections of disposal sites and conditioning of discharges of dredged or fill material. 40 FR 41293, 5 September 1975.

US Environmental Protection Agency. 1976. Quality criteria for water. Washington DC, 256 p.

US Environmental Protection Agency. 1977a. Final environmental impact statement for Albuquerque wastewater treatment facilities. Dallas TX, 282 p.

US Environmental Protection Agency. 1977b. Final environmental impact statement for Albuquerque wastewater treatment facilities, project no. C-35-1020-01, Albuquerque, New Mexico. Dallas TX, 290 p.

US Environmental Protection Agency. 1977c. Technical reference document for Albuquerque wastewater treatment facilities. Dallas TX, variously paged.

US Environmental Protection Agency. 1978a. Condensed version of EPA levels document. Office of Noise Abatement and Control. EPA 550/9-79-100. Washington DC, 25 p.

US Environmental Protection Agency. 1978b. Criteria for classification of solid waste disposal facilities. 40 CFR 257, 43 FR 25, 6 February 1978.

US Environmental Protection Agency. 1979a. Final regulations regarding the National Pollutant Discharge Elimination System. 40 CFR Parts 121, 122, 124, 125.

US Environmental Protection Agency. 1979b. Floodplain management and wetlands protection. Federal Register, 5 January 1979.

US Environmental Protection Agency. 1979c. Gamma radiation treatment of waters from lignite mines. EPA-600/7-79-064. Cincinnati OH, 91 p.

US Environmental Protection Agency. 1979d. Health effects association with wastewater treatment and disposal systems: state-of-the-art review. Volume 1, pp. 423-439.

US Environmental Protection Agency. 1979e. Implementation of procedures on the National Environmental Policy Act. 40 CFR Part 6; 44 FR 216: 64174-64192, 6 November 1979.

US Environmental Protection Agency. 1979f. Requirements for preparation, adoption, and submittal of implementation plans: prevention of significant deterioration of air quality. 40 CFR 51.24, 44 FR 8237, 8 February 1979.

US Environmental Protection Agency. 1979g. Working guidelines for the preparation of environmental impact statements. Memo from C. B. Spotts, US Environmental Protection Agency Region 6 to EIS preparers dated August 1979. Dallas TX.

US Environmental Protection Agency. 1980a. A guide to regulations and guidance for the utilization and disposal of municipal sludge. Washington DC, 48 p.

US Environmental Protection Agency. 1980b. A survey of pathogen survival during municipal solid waste and manure treatment processes. Cincinnati OH, 105 p.

US Environmental Protection Agency. 1980c. Final environmental impact statement for water, sewer and access facilities, South University Industrial Park. Albuquerque NM, variously paged.

US Environmental Protection Agency. 1980d. Hazardous wastes and consolidated permit regulations. 40 CFR 260-265, 45 FR 98, 19 May 1980.

US Environmental Protection Agency. 1980e. Potential health effects from persistant organics in wastewater and sludges used for land application. Health Effects Research Laboratory, 51 p.

US Environmental Protection Agency. 1980f. Regulatory options for the control of odors. EPA-450/5-80-003. Research Triangle Park NC, variously paged.

US Fish and Wildlife Service. 1980. Endangered species of Arizona and New Mexico. USFWS Region 2. Albuquerque NM, 63 p.

US Geological Survey. 1952a. Albuquerque east quadrangle, New Mexico, 7.5 minute series (topographic). Department of the Interior, Washington DC, 1 sheet.

US Geological Survey. 1952b. Albuquerque west quadrangle, New Mexico, 7.5 minute series (topographic). Department of the Interior, Washington DC, 1 sheet.

US Geological Survey. 1952c. Hubbell Spring quadrangle, New Mexico, 7.5 minute series (topographic). Department of the Interior, Washington DC, 1 sheet.

US Geological Survey. 1952d. Isleta quadrangle, New Mexico, 7.5 minute series (topographic). Department of the Interior. Washington DC, 1 sheet.

US Geological Survey. 1978. Water resources data for New Mexico. Water year 1978. US Department of the Interior. Washington DC, 677 p.

US Geological Survey. 1980. Water resources data for New Mexico. Water year 1979. US Department of the Interior. Albuquerque NM, 747 p.

US Nuclear Regulatory Commission. 1980. Regulatory guide 10.9/guide for preparation of applications for licenses for the use of gamma irradiators. Office of Standards Development. Washington DC, 15 p.

Vanervan, J. 1981. Phone, John Vanervan, Bernalillo County Planning Commission, 26 June 1981.

Vesiland, P.A. 1980. Treatment and disposal of wastewater sludges. Ann Arbor Science, Ann Arbor MI, 323 p.

Ward, R.L. 1978. Mechanism of poliovirus inactivation by ammonia. Journal of Virology 26(2):299-305

Ward, R.L. 1980. Mechanism of poliovirus inactivation by the direct and indirect effects of ionizing radiation. Radiation Research 83:330-344

Ward, R.L., and C.S. Ashley. 1977a. Discovery of an agent in wastewater sludge that reduces the heat to inactivate reovirus. Applied and Environmental Microbiology 34(6):681-688.

Ward, R.L., and C.S. Ashley. 1977b. Inactivation of enteric viruses in wastewater sludge through dewatering by evaporation. Applied and Environmental Microbiology 34(5):564-570.

Ward, R.L., and C.S. Ashley. 1978a. Heat inactivation of enteric viruses in dewatered wastewater sludge. Applied and Environmental Microbiology 36(6):898-905.

Ward, R.L., and C.S Ashley. 1978b. Identification of detergents as components of wastewater sludge that modify the thermal stability of reovirus and enteroviruses. Applied and Environmental Microbiology 36(6):889-897.

Ward, R.L., and C.S Ashley. 1978c. Methods to inactivate enteric viruses in wastewater sludge. Prepared by Sandia Laboratories for the US Department of Energy. Albuquerque NM, 23 p.

Ward, R.L., and C.S Ashley. 1978d. Notes: comparative effects of ammonia and related compounds on poliovirus. Applied and Environmental Microbiology 36(1):198-200.

Ward, R.L., and C.S. Ashley. 1979a. Mode of initiation of cell infection with sludge-associated poliovirus. Applied and Environmental Microbiology 38(2):329-331.

Ward, R.L., and C.S. Ashley. 1979b. pH modification of the effects of detergents on the stability of enteric viruses. Applied and Environmental Microbiology 38(2):314-322.

Ward, R.L., and C.S. Ashley. 1980a. Comparative study on the mechanisms of rotavirus inactivation by sodium dodecyl sulfate and ethylenediamine tetraacetate. Applied and Environmental Microbiology (39)6: 1148-1153.

Ward, R.L., and C.S. Ashley. 1980b. Effects of wastewater sludge and its detergents on the stability of rotavirus. Applied and Environmental Microbiology 39(6):1154-1158.

Ware, S.A. 1980. A survey of pathogen survival during municipal solid waste and manure treatment processes. EPA-600/8-80-034. Ebon Research Systems. Cincinnati OH, 105 p.

William Matotan & Associates, and Molzen-Corbin & Associates. 1978a. Final Albuquerque areawide wastewater collection and treatment facilities plan. Prepared for City of Albuquerque, New Mexico. Albuquerque NM, Volume 1, variously paged.

William Matotan & Associates, and Molzen-Corbin & Associates. 1978b. Final Albuquerque areawide wastewater collection and treatment facilities plan. Prepared for City of Albuquerque, New Mexico. Albuquerque NM, Volume 2, variously paged.

William Matotan & Associates, and Molzen-Corbin & Associates. 1978c. Final Albuquerque areawide wastewater collection and treatment facilities plan. Prepared for City of Albuquerque, New Mexico. Albuquerque NM, Volume 3, variously paged.

William Matotan & Associates, and Molzen-Corbin & Associates. 1978d. Final Albuquerque areawide wastewater collection and treatment facilities plan. Prepared for City of Albuquerque, New Mexico. Albuquerque NM, Volume 4, variously paged.

Wilson & Company Engineers & Architects. 1980a. Interim sludge disposal facilities engineering report. Prepared for City of Albuquerque, New Mexico Water Resources Department. Albuquerque NM, variously paged.

Wilson & Company Engineers & Architects. 1980b. Preliminary technical and economic analysis of solar sludge drying facility. Prepared for City of Albuquerque. Albuquerque NM, variously paged.

Wilson & Company Engineers & Architects. 1981. Interim technical and economic analysis of solar sludge drying facility engineering report. Prepared for City of Albuquerque, New Mexico Water Resources Department. Albuquerque NM, variously paged.

Wooldridge & Stednick. 1980. Effects of sludge irrigation on three Pacific Northwest forest soils. US Environmental Protection Agency. Cincinnati OH, 170 p.

Yeager, J.G. 1980. Risk to animal health from pathogens in municipal sludge. Sandia National Laboratories. Albuquerque NM, 40 p.

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CHAPTER 10.0 APPENDIXES

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CHAPTER 10.0
APPENDIXES

10.1 SIGNIFICANT CORRESPONDENCE

STATE OF NEW MEXICO
DEPARTMENT OF FINANCE AND ADMINISTRATION
STATE PLANNING DIVISION

BRUCE KING
GOVERNOR

KATHLEEN R. MARR
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SANTA FE, NEW MEXICO 87503
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ANITA HISENBERG
DIRECTOR

JOE GUILLEN
DEPUTY DIRECTOR

April 23, 1981

RECEIVED
APR 27 1981
EPA
REGION 6
S & A DIV.

Mr. Clinton B. Spotts
U.S. Environmental Protection Agency,
Region VI
1201 Elm Street
Dallas, Texas 75270

ATTN: Darlene Owsley

Dear Mr. Spotts:

Thank you for sending us a copy of the report on the archaeological reconnaissance of the City of Albuquerque's proposed Montessa Park sludge treatment and storage system and associated sludge conveyance pipeline.

The survey of the sludge treatment and storage site and the proposed pipeline conducted by WAPORA, Inc. is clearly adequate. We concur with your determination that the project will have no effect on any significant cultural resources.

Mr. Banks' observations on the likelihood of buried archaeological remains in the Tijeras Arroyo and the Rio Grande floodplain are well taken. If such buried remains are uncovered, artifacts and features should be protected in place and this office notified of the find. We would also like to remind you that any alterations to the project involving new areas will require further review by this office.

If you have any questions concerning our comments, please let us know.

Sincerely,

Thomas W Merlan

Thomas W. Merlan
State Historic Preservation Officer
Historic Preservation Bureau

TWM:CJLB:dg

IN REPLY REFER TO:
SE

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

September 10, 1980

RECEIVED
SEP 15 1980
EPA
REGION VI
S & A DIV.

Mr. Clinton B. Spotts
Regional EIS Coordinator
U.S. Environmental Protection
Agency
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

This is in reply to your letter of August 27, 1980, which requested information about species which are listed or proposed to be listed as threatened or endangered as provided by the Endangered Species Act. Your area of interest is the Albuquerque Sludge Treatment and Disposal System, Bernalillo County, New Mexico.

The Fish and Wildlife Service provides upon request a list of those species, both proposed and listed, which may be affected by Federal construction activities.

Our data indicate no listed or proposed species would be affected by the proposed action in the area of interest. If I may be of further assistance, do not hesitate to call the Endangered Species Office (505-766-3972; FTS 474-3972).

Sincerely yours,

R. F. Stephens

Acting
Regional Director

cc: Area Manager, Phoenix Area Office (SE), Phoenix, Arizona
Field Supervisor, Albuquerque Field Office (ES), Albuquerque, New Mexico

10.2 DESCRIPTION OF CESIUM-137 IRRADIATOR

DESCRIPTION OF CESIUM-137 IRRADIATOR

The irradiator is designed to utilize the gamma rays from cesium chloride (Cs-137) to disinfect Albuquerque's sewage sludge. The highest penetrating dose rate to personnel working at the irradiation facility is expected to be 0.05 rem per year for a total of seven to eight individuals (McMullen 1981). The federal standard for radiation workers is the equivalent of 5 rem/year (10 CFR part 20.101). For comparison, the natural external radiation background in the Albuquerque area has been measured to be approximately 150 to 200 millirem (.15 to .2 rem) per year per person (ERDA 1977). The dose rate expected outside the facility during operation and decommissioning is expected to be essentially zero (unable to differentiate from background radiation at 3 to 10 feet from the facility). The primary shielding of the cesium chloride gamma ray source will be the massive steel reinforced concrete structure of the facility (McMullen 1981).

The irradiator for Albuquerque has not been designed yet, but will use as a guide the "As Low As Reasonably Achievable" (ALARA) concept for radiation exposure. This concept holds that although exposure can be reduced to whatever level is desired through use of additional radiation shielding and operating procedures, in actual practice a trade-off has to be negotiated to hold facility construction costs within reasonable bounds while limiting radiation exposure to "reasonable" levels. If the irradiator alternative is chosen for the Albuquerque Wastewater Treatment Plant the irradiator will incorporate safety features at least as stringent as those present at the Sandia Irradiator for Dried Sewage Solids (SIDSS) pilot facility located at Sandia National Laboratories in Albuquerque. Any improvements that have been learned from work at the SIDSS also will be incorporated (Khera 1981). The New Mexico Environmental Improvement Division (EID) is requesting a full-time position for someone whose primary responsibility would be to supervise the licensing, construction, and operation of the Albuquerque irradiator should this option be chosen. This person would serve as a liason between the EID and the City of Albuquerque, Sandia National Laboratory, and the Department of Energy and would be involved with the assessing of risks, environmental assessments, and assuring compliance with the EID regulations (by phone, Benito Garcia, NM-EID, 23 July 1981).

When dealing with large quantities (approximately 5 to 7 MCi) of radioactive material, there is always the potential of overexposure and/or the release of radioactive material resulting from abnormal events. It is highly improbable that any of these abnormal events or accident would result in overexposure to the occupational personnel or the general public from radiation. The most realistic accidents which could be expected are: pool cover drop, transportation cask or source pin drop, shielding water release, pool cover removed without water in the pool, problems with the shutter, source pin leak, fire, explosion, security problems, and accidents caused by natural events. The information for the discussion of these accidents was taken from the Sandia Irradiator for Dried Sewage Solids Final Safety Analysis Report (Morris 1980).

- Pool Cover Drop

The pool cover will consist of three separate, high density concrete slabs placed on top of each other over the pool cavity. The covers are removed individually with a crane and cable sling which attaches at four lifting points built into each cover. Failure of the crane or cable assembly or a fracture of the lid during movement would cause all or part of the cover to drop either onto other covers, onto the pool edge, onto the ground, or into the pool. Possible damage to the facility is minimized by restricting the lift height of the covers and insuring that all lifting equipment be designed with safety factors of 400 percent or greater.

In preparation for removing the pool cover, the source plaque is extended into the cavity between the pool area and the conveyor area to provide further protection. Any objects falling into the pool could damage only the cable assembly and drive arms, but not the source plaque.

It is highly improbably that over exposure or release of radioactive material would be caused by an accident of this type. Depending on the extent of damage, the radioactive source may have to be removed from the facility to allow access for repair.

- **Transportation Cask or Source Pin Dropped**

The gamma-source pins are transported in Department of Transportation approved casks. The cask consists of a base which holds the pins and a cover that is bolted in place. A double cable sling arrangement is used to lift the cask and lower it into the water-filled pool. After the pins have been removed from or installed in the cask, the cask is lifted out of the pool.

During these operations, it is possible that crane operator misjudgement or mechanical failure of the crane, sling, or cask could result in the cask being dropped. If the cask were dropped outside the facility, no damage would occur because the cask is adequately designed to sustain drops of 30 ft onto an unyielding surface. If the cask were dropped while over the pool area, the fall would be less than 30 ft. The stainless-steel pool liner might be damaged slightly, but the 24-in-thick conrete base of the facility could sustain the impact without major structural damage. In order to minimize any possibility of damage to the source plaque during the cask-lifting operations, the arms are disconnected from the source plaque, the source plaque is pushed into the cavity between the conveyor and pool areas, and the lead shutter is closed before the cask is lifted. The lead shutter and the concrete above the cavity provide substantial protection to the source plaque. There is the possibility that a source pin could fall from the source plaque during normal operation. The facility has been designed to reduce this possibility. If a source pin were to fall from the source plaque, loss of integrity of the source pins would be extremely improbable since the capsules have been designed to withstand a 30 foot drop and the source plaque will be not more than 6 feet above the surface (by phone, Neil Hartwigson, Sandia National Laboratories, 22 July 1981).

It is not expected that either of these accidents would release any radioactive material or cause overexposure to the occupational personnel. The facility base and pool liner might be damaged.

- Shielding Water Release

The pool must be filled with water for gamma-ray shielding during gamma-source pin loading or unloading or during repair operations on mechanical equipment installed in the pool area. During any operation that involves removal of the concrete pool covers, automatic water level controllers and water level alarms will be temporarily installed. Accidental release of this shielding water could result in radiation exposure of personnel working in the area. Release of the pool water could be caused by inadvertent operation of the pool-emptying sump pump, a leak in the water seal installed in the conveyor area, or a massive fracture of the pool sides.

Accidental release of the shielding water could occur by sump pump actuation. The facility will not have a gravity or natural drain from the pool storage area. All water will have to be pumped out. The sump pump will be a low-volume pump capable of 10 gal/min. At that rate, the pump would require 23.9 hrs of unnoticed operation to drain the pool. The accidental use of the sump pump is prevented by the interlock system while the alarm systems are on.

The other possibility of water leakage is through the water seal between the conveyor area and pool area. This normally would amount to a small volume of water leakage. The control system will prevent the removal of the pool covers without there being an adequate water level in the pool. If no water were added, the water in the pool side would leak into the conveyor side and eventually stabilize at a depth of 7 ft 7 in above the pool floor. Additional water would, however, automatically be added to provide adequate protection from the source plaque.

In the event of a massive fracture to one of the pool sides, the automatic water-fill system could probably keep the pool full until emergency action could be taken. If the fill apparatus could not keep up with the leakage, a high-rate fill hose would be used to keep the pool full until the covers could be replaced or the source material removed.

In all the above situations, the automatic water level controller would compensate for minor leaks (less than 1 gal/min) and the alarms would sound if the water level changes more than 2 inches below the required level.

In general, water release does not represent a very significant hazard because the release would occur at a very slow rate compared to the pool capacity. This slow leakage rate allows adequate time for corrective action to be taken.

- Pool Cover Removed Without Water in Pool

The pool cover is removed when charging or recharging the facility. Pool cover removal without shielding water being present would represent a radiation exposure hazard to personnel. During the procedures to be followed for pool cover removal, Health Physics personnel will be present with monitoring equipment. Since the pool cover consists of three separate covers, readings will be made to assure that the radiation levels stay within predetermined levels as each cover is removed.

The facility safety design uses both a mechanical and an electrical interlock system to prevent cover removal without water in the pool. There are two pool cover locks; one is released if the float switch senses the proper water level, and the second is released if a mechanical bellows senses the proper water pressure. Furthermore, the removal of the pool cover can occur only if the key-controlled function switch is in the LOAD-UNLOAD mode of operation. If all systems failed, there would not be any damage to the facility or release of radioactive material, but a potential would exist for a low-level radiation exposure of personnel while the first cover was removed.

- Shutter Problems

The lead shutter provides the necessary shielding from the retracted source to allow access into the conveyor area. There are various problems that could develop with the shutter such as the shutter being open when personnel are in the conveyor area, the shutter jamming open, and the shutter closing on the source plaque.

The facility will be designed with back up systems to ensure that the shutter can not be open while the facility is in the access mode. The entrance to the conveyor area is made through the access cover which has two locks. One lock is released by a mechanical bellows and indicates that the shutter is closed. When the access cover is removed, the mechanical interlock system and the electrical interlock system separately lock the shutter drive. In addition, the power to the drive motor is shut off. As a result, entrance can be made only when both interlock systems provide a positive indication that the shutter is closed. Once access is gained, the shutter cannot be operated. Once the access cover has been removed (with a crane), a qualified health physicist will survey the access area with a radiation survey meter before other personnel are allowed to enter.

The shutter is moved on an electrical-mechanical system and has a number of components that may fail resulting in the shutter remaining open. With the shutter in the open position, the water seal cannot be installed due to radiation exposure that would be encountered. As a result, any repair of the drive system elements located within the facility, such as chain arrangement or the lead screw, would require filling the facility with water. Since the water seal is not in place, water would fill both the pool area and the conveyor area, but this represents no serious damage to the facility. If extensive repairs to the shutter are needed, the source material might have to be unloaded from the facility and the pool drained. A more serious problem would be created if the source material is in the conveyor area and the shutter jams partially open. In this situation the shutter would have to be fully opened before the source material could be moved into the pool area and removed. This incident would not result in release of radioactive material or overexposure. In the worst case it would present a very time consuming problem to overcome (by phone, Neil Hartwigson, Sandia National Laboratories, 22 July 1981).

There is a remote possibility of the lead shutter closing on the source plaque while the source plaque is not completely retracted. This event is mentioned since the two devices travel paths that cross each other at right angles. The prevention of this type of accident is covered by a number of features included in the design of the facility. The source plaque has both electrical and mechanical sensing devices that indicate when the shutter is totally retracted. Without both types of sensing switches indicating retraction, the shutter cannot be operated. The converse also holds; that is, the source plaque drive system cannot be operated until both sensing systems on the lead shutter indicate the shutter is open. In addition, radiation sensors are an integral part of the control system that determines the location of the source plaque and the shutter. Control panel logic prevents movement of either device unless the other device is determined to be in the proper position. Assuming both control panel logic failure and the failure of the dual sensing indicators, the final safety measure includes the torque limiting clutches of each of the drive motors. These devices would minimize damage if the two devices were driven simultaneously.

The result of this type of accident could be damage to either the shutter or the source plaque or both. Any damage, however, would be minimal because of torque-limiting clutches on both drives. Repairing damage from this type of accident would require filling the facility with water and performing repairs as needed. Depending on the severity of the repairs needed, the radioactive material may have to be removed by normal unloading procedures. This type of accident would represent no serious damage to the facility or harm to personnel.

- Source Pin Leak

During normal operation, the source pins are extended into the conveyor area. If a pin were to develop a leak, radioactive material could be discharged and either settle in the facility or be carried by the cooling air system up to the double High Efficiency Particulate Air (HEPA) filter discharge-air filtering system. The only ways for a pin to develop a leak that can be envisioned are defective capsule welds, corrosion from within or outside the capsule, and mechanical fracture from malfunction of the conveyor, source plaque drive, or lead shutter.

The welds on the outer capsule are leak-checked by filling the void between the capsules with helium before welding. After the weld is made, the capsule is leak-checked with a residual helium analyzer.

Materials compatibility studies have determined that capsules stored in water and for up to 2 months in air show no degradation of the inner stainless steel liner upon sectioning. These tests were conducted using pure Cs-137 instead of the combination of Cs-137, Cs-133, and Cs-135 which will be the actual combination used at the Albuquerque Facility. Material compatibility studies are currently being conducted on a source pin containing this combination of Cesium isotopes.

Substantial mechanical protection is provided for the source pins in the source plaque frame and in the housing that surrounds the source plaque while it is in the extended position. Torque-limiting clutches are provided for all mechanical equipment that could exert force on the source plaque during a malfunction.

In order to detect a leak in the capsules after installation in the facility, the following tests will be performed periodically: thermoluminescent dosimetery, swipe test, and flooding the source plaque (in the pool area) with water and testing the water for radioactivity. The actual scheduling and requirements for these tests will be specified in the license which will be obtained from the Environmental Improvement Division of the State of New Mexico (by phone, Neil Hartwigson, Sandia National Laboratory, 22 July 1981).

Were a leak to develop in a source pin from any of the causes discussed, the minute traces of radioactive material discharged would most likely remain on the surface of the capsule where it would be detected by swipe tests. If enough material were to leak so that it fell from the capsule, the material would become airborne and either be filtered by the

HEPA filters or settle on the open surfaces in the facility. If any material settled onto the buckets, which is extremely improbable, a radiation sensor would turn off the conveyor before the material reached the outside. If water dissolved some of the cesium chloride, a radiation sensor would prevent the sump pum from pumping it to the water holding tank.

If the beta-gamma air monitor, which is located after the second filter surface, detected radioactive material, the air entering the filter would be sampled about one foot ahead of the filters through an air sampling port. If the air samples corroborated the presence of radioactive material, the source plaque would be retracted into the pool area and the lead shutter closed. Sampling filters placed in line after the beta-gamma air monitor take a cumulative recording of any radioactive releases from the facility. The HEPA filters will be check before and after installation by health physics representatives. If swipe tests did not detect which capsule was leaking, the pins would have to be loaded for transportation back to Richland, WA. The shielding water would probably become slightly contaminated during this loading procedure. The facility would have to be thoroughly decontaminated after the accident. The water would also have to be decontaminated before discharge. The ion exchange resin and the ion exchange columns used to decontaminate the facility and the shielding water would have to be disposed of in approved radioactive waste disposal sites.

A leak in a source pin would not result in release of radioactive material or overexposure unless the safety backup systems did not operate correctly (i.e., both HEPA filters were to leak, radiation sensors malfunctioned, etc.).

- Fire

The facility structure and internal components of the facility are classed as non-combustible material, therefore the fire concern is limited to the sludge passing through the conveyor. Heat detectors in the conveyor area are used to detect a fire and initiate an extinguishing system. If the heat detectors sense an abnormal condition, the audible and visible alarm systems are activated and the hopper feed system shuts down. Another preventive measure controlled by a heat detector is the actuation of a solenoid valve that releases carbon dioxide (CO_2) into the conveyor area. If for some reason the CO_2 does not work it is still highly unlikely that the fire would cause damage to the source pins. A fire could cause operational difficulties, but the probability of release of radioactive material or overexposure is very small (by phone, Neil Hartwigson, Sandia National Laboratories, 22 July 1981).

- Explosion

The only potentially explosive material within the facility considered explosive is the small amount of organic dust from the sludge. This dust may be explosive when exposed to open flames. No burning occurs as part of the facility operation, thereby reducing this possibility. If any buildup of the dust occurs, the conveyor system will be vacuumed on a regular basis to alleviate the condition. The sludge to be irradiated in this facility will contain a limited amount of moisture to minimize the generation of dust. Tests will be conducted to determine the proper amount of moisture needed to prevent dust generation.

If this event did occur, the explosion would occur within the conveyor system which is constructed of 1/8 inch steel panels. The conveyor also is open to the atmosphere at the load and unload points which provide a vent path that aids in relieving a pressure buildup within the conveyor. Further, it is improbable that the pressure generated by a dust explosion would damage the source pins (by phone, Neil Hartwigson, Sandia National Laboratory, 22 July 1981).

- Security Problems

Cs-137 is not considered a special nuclear material (i.e., material from which nuclear explosives can be built and therefore safeguards are not required by the NRC license (US NRC 1980). The facility will be designed to limit access to the radioactive source by unauthorized people. The facility will have an industrial level of security which will probably consist of controlled access through a fence and locked gate. The fence and gate would keep the general public away from the irradiator but would do little to deter a terrorist determined to gain entry. If terrorists were to gain entry, they would need protection from the gamma rays if they tried to reach the source. Otherwise, they would quickly become disabled. The massive concrete shielding would offer some protection from the potential release of radioactive material caused by an explosion (by phone, Neil Hartwigson, Sandia National Laboratory, 22 July 1981).

Irradiators have operated on a commercial basis for years without security problems that could endanger the public. Although considered unlikely, it could be possible for someone determined to cause mass destruction to destroy the irradiator and release radioactive material to the environment.

- Natural Events

Earthquakes, floods, and tornadoes are natural events which could result in damage to the facility.

Seismic activity for the Albuquerque-Belen Basin has a relatively high occurrence rate, but the magnitudes are low, on the order of Richter magnitude 3.5 or less. Earthquakes of higher magnitude have occurred; however, geological evidence indicates that significant earth movement has not occurred for several hundred years, and historical evidence indicates that the largest earthquake expected within a 100-year period is Richter magnitude 6.0. The low intensity of the earthquakes coupled with the substantial structure (mostly underground) of the facility should provide adequate protection.

The irradiator site at Montesa Park is located 20-30 feet above the 100 year flood plain for the Tijeras Arroyo, therefore the probability of flooding from the Tijeras Arroyo is very low. Localized sheet flooding due to thunderstorm acitivity does occur occasionally but a slight grade up to the facility will prevent this minor flooding from affecting the facility. If flood water entered the facility, the damage to the facility should be minor and the sump pump would clear it out. The likelihood of the flood water coming into contact with the radioactive material is extremely low since an undetected leak in a source pin would have to occur, concurrently.

Albuquerque is classified as a region of low occurrence of tornadoes, with an annual frequency of 0.1 or less. Because of the low frequency of tornadoes and the fact that most of the structure of the facility is underground, tornadoes are not a significant design consideration. If a tornado were to pass directly over the facility, the most severe damage expected would be damage to the part of the conveyor that extends above the facility.

The technology for using Cs-137 to disinfect sewage sludge is new; however, irradiation is used routinely to sterilize certain pharmaceutical equipment. Most of the existing irradiators use cobalt (Co-60) as the source of gamma rays. Although the Albuquerque irradiator will be larger than the existing irradiators and uses a different gamma ray source, the basic technology is similar and therefore it would be useful to present the safety record of some of the existing irradiators. The Director of the appropriate Nuclear Regulator Commission (NRC) must be notified within 24 hours of any incident involving the radioactive material which may have caused or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed certain specified limits; or

(3) A loss of one day or more of the operation of any facilities affected; or

(4) Damage to property in excess of $2,000 (10 CFR part 20.403).

NCR Region 1 includes the following states: Connecticut, Delaware, District of Columbia, Main, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. The safety records for this region is for six irradiators and includes the records from those states which have been delegated the licensing authority (Agreement states). The most serious incidents involved the radiation exposure to a worker. In both cases, the worker entered the conveyor area when the source plaque was exposed. The interlock systems had been by passed for legitimate reasons but had failed to be reinstated. This type of accident occured twice in the past seven years and was primarily caused by the neglect of operational safety procedures. There have been two fires at irradiator facilities in NRC Region 1 in the last five years. On both occasions the conveyor became stuck and the process material became overheated. These incidences resulted in no overexposure and no release of radioactive material. Three source pin leaks occurred in the last eight years. The shielding water became contaminated and therefore required cleaning. These incidences resulted in no overexposure and no release of radioactive material (by phone, Frank Costello, NRC Region 1, 16 July 1981).

The incident reports for NRC Region 2 will cover approximately 12 irradiators in Virginia, West Virginia, Puerto Rico, and federal licensees in the Agreement states. There have been no accidents in Region 2 for the last three years (by phone, Bob Brown, NRC Region 2, 16 July 1981).

There have been no (0) incidents in NRC Region 4 out of three irradiators in the last five years. This information does not cover the Agreement states in this region and is therefore limited to Oklahoma, Utah, Wyoming, Montana, and South Dakota. New Mexico and Texas are two of the Agreement states in this region. New Mexico has licensed only one very small irradiator, but Texas has licensed five irradiators. The Texas Department of Health is notified under the same conditions as the NRC with the exception of the fourth condition where Texas requires notification if damage to property is in excess of $1,000. Texas has had three incidents reported since 1974. One incident involved a frayed hoist cable which hindered the source plaque from moving into the irradiation mode after a shutdown. This problem was resolved within 3 days without complication. There was no radiation overexposure or release. The second incident involved a leak in the pool area and resulted in no radiation exposure. In the third incident it was determined that through an unlikely series of events, it could be possible for a person to enter into an area while the source plaque was not shielded. The safety systems were re-worked to rectify this situation (by letter, Bob Free, Texas Department of Health, 6 July 1981).

Definitions

curie (Ci) - The basic unit used to describe the intensity of radioactivity in a sample of material. One curie (Ci) equals 37 billion disintegrations per second.

HEPA - High efficiency particulate air filter. A type of filter designed to remove 99.9 percent of particles down to 0.3 um in diameter from a flowing air stream.

rad - Radiation absorbed dose. The basic unit of absorbed does of ionizing radiation. One rad is equal to the absorption of 100 ergs of radiation energy per gram of matter.

rem - A dose unit which takes into account the relative biological effec tiveness (RBE) of the radiation. The rem ("roentgen equivalent man") is defined as the dose of a particular type of radiation required to produce the same biological effect as one roentgen of (0.25 Mev) gamma radiation. A millirem (mrem) is one thousandth of a rem.

10.3 DESCRIPTION OF ELECTRON BEAM

DESCRIPTION OF ELECTRON BEAM IRRADIATION

INTRODUCTION

Electron beam irradiation is being considered as one of the alternatives for sludge disinfection at Albuquerque, New Mexico. Due to its limited application, Electron Disinfection Process qualifies under the EPA criteria established for innovative and alternative technology. Surprisingly industry has employed the system for over 15 years. The high energy source for irradiating the sludge is beta-rays (i.e., high energy electrons). High energy electrons are generated from an accelerator under an electrical potential of 1.5 million volts.

PROCESS DESCRIPTION

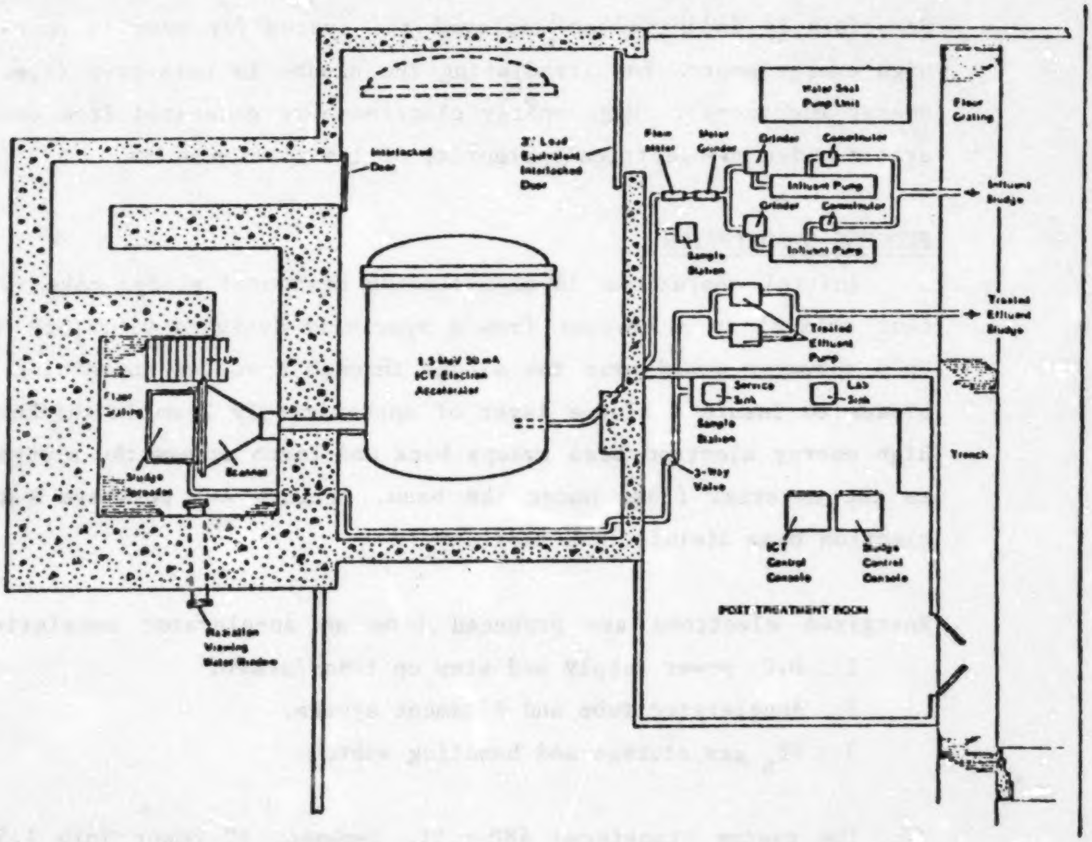
Initial operations involve feeding dewatered sludge cake (20 percent solids) to a coveyor from a specially designed vibratory hopper. This conveyor would pass the sludge through a roller containing doctor blades to insure a sludge layer of approximately 2 mm in thickness. A high energy electron beam sweeps back and forth across the sludge layer as the material flows under the beam. Figure A-1 portrays a typical electron beam disinfection facility.

Energized electrons are produced from an accelerator consisting of:

1. D.C. power supply and step up transformer.
2. Accelerator tube and filament system.
3. SF_6 gas storage and handling system.

The system transforms 480-volt, 3-phase, AC power into 1,500,000 volt DC power within a separate tank of SF_6 gas. This voltage leaves the tank through a short high voltage cable to a insulated acceleration tube which is mounted in the upper region of a vault. The DC voltage excites the tungsten filament which emits electrons that are forced by the electric field towards the positive electrode of the tube. Each electron now has acquired 1.5 MeV energy. The electrons now move at 94 percent the speed of light and continue into an evacuated chamber where they are swept back and forth by the electron beam scanner. They pass

FIGURE A-1
ELECTRON BEAM DISINFECTION FACILITY


Water Seal Pump Unit
Floor Grating
Interlocked Door
3' Lead Equivalent Interlocked Door
Flow Meter
Meter Grinder
Grinder
Comminutor
Influent Pump
Influent Sludge
Grinder
Comminutor
Influent Pump
Sample Station
Treated Effluent Sludge
Treated Effluent Pump
Up
Floor Grating
1.5 MeV 50 mA ICT Electron Accelerator
Service Sink
Lab Sink
Sample Station
Trench
Sludge Spreader
Scanner
3-Way Valve
ICT Control Console
Sludge Control Console
POST TREATMENT ROOM
Radiation Viewing Water Window

from the chamber into the atmosphere through a long thin metal window. The curtain of high energy electrons impinges on the full width of the moving band of sludge a short distance below.

During the brief exposure to the disinfecting dose, over 10 trillion energized electrons impinge on each square centimeter of the sludge surface. As these electrons lose energy in collisions with atoms and molecules, they produce ionization which causes powerful disinfecting and detoxifying effects. The absorbed energy from this dosage raises the temperature of the water approximately 1°C.

The direct bombardment of high energy electrons produces ionized hydroxyl groups and ozone. During its life time, a single electron can produce 10,000 of these powerful oxidizing and reducing compounds. Therefore, one quintillion of these oxidizing/reducing compounds impinge upon a square centimer of sludge cake. Considering that anaerobically digested sludge harbors 5,000,000 bacteria per ml. There are over one million of these compounds attacking each bacteria. This results in almost total pathogen mortality.

PUBLIC HEALTH

The disinfection of sludge with electron beam technology has several distinct advantages over the other methods of sludge disinfection. Unlike composting, electron beam radiation affords almost complete pathogen kill. Pathogen reductions of almost 2.5-5.6 logs have been achieved in liquid sludges under a 400 kilorad dose. Coliform levels of under 10 coliforms per milliliter of sludge are achievable with this process.

Studies have been performed on viral destruction with electron beam technology. Data analysis of these viral studies indicate results similar to pathogen studies. Minimum reduction of 90 percent or more have been achieved with a 400 rad dose. Further reductions of 2-2.6 logs have been realized through this process. Considering that virus levels in sludge are approximately 10,000 times lower, a 2-log reduction in virus populations translates into a limited survival of viruses in a milliliter of sludge.

In land disposal of sludge, the survival of pathogenic parasites (e.g., ova of ascaris worms) poses public health problems. These organisms can survive in the soil for long periods and propagate from grazing animals to the human population or transfer directly from soil or plant to humans. These parasites and their eggs present relatively large targets to the electron beam and are totally destroyed.

Electron irradiation may have an additional advantage in that it destroys toxic organic chemicals resident in some sludges. These toxic organic chemicals comprise pesticides, PCB's, herbicides, organic solvents, and certain other carcinogenic compounds which are untouched by most treatment processes, including incineration. Electron beam energy produces hydroxyl compounds and sufficient activation energy to degrade these compounds. Research to date has been directed at PCB's and near total destruction has been documented.

High energy electrons bombarding surfaces produce X-rays. Because of the low fractional conversion of electron beam power into X-ray power and the low absorption of this penetrating X-ray power into the sludge, such X-rays contribute little to the disinfection process. However, their presence requires special shielding of the entire region within which deceleration of energized electrons takes place. For the particular application at Albuquerque, the central vault would require 6 ft. of high density concrete to contain the X-rays.

In order to prevent accidental exposure of workers to X-rays, a special interlocked door and electron beam arming system are built into the design. Should workers need to enter the central vault, opening the interlocked door will disarm the unit. For the unit to be re-armed, the worker must re-arm the control console within a certain time limit or the unit will become inoperable. Several types of safety systems are usually included in the design to provide redundancy in the system and eliminate any chance of accidents.

The electron beam disinfection process has a definite advantage over composting and gamma radiation since the unit can be shut down without any major preparations. This aids in maintenance since after shut down of the unit, all parts of the system are accessible for repairs. Unlike the gamma-radiation disinfection alternative, the problem with containing the radioactive isotopes during maintenance is not critical. Unlike composting, problems associated with a backlog of materials going "stable" do not threaten the continuity of the process.

10.4 PUBLIC HEALTH INFORMATION

PUBLIC HEALTH INFORMATION

AN OVERVIEW OF WATERBORNE DISEASES

The possibility of transmitting disease is a major part of public anxiety about sludge handling and disposal operations. An overview of the types of waterborne diseases and their possible pathway through solid waste management processes is provided. The reader is asked to note that safety guidelines for these pathogens have not been established and that the research conducted on the transmittal of disease has focused on liquid waste management. Problems associated with sludge treatment and disposal operations and their separate role in the pathway of disease transmittal is still considered a subordinate element of solid or liquid waste management, and therefore have not been singled out for extensive research. The following section therefore will present an overview of the types of infectious agents which may be found in both wastewater effluent and solid waste (sludge) and their potential for causing disease due to waterborne transmission. Infectious agents include various bacteria, viruses and parasites. Overall, waterborne transmission of disease is low and cases which have been identified have been traced to: (1) deficiencies in water treatment, (2) deficiencies in distribution systems, (3) use of untreated surface water, and (4) use of untreated groundwater. No reported cases resulted directly from inadequate operation of a municipal wastewater treatment system (Crites and Seabrook 1979).

The relationship between numbers of specific disease-causing organisms in water and the potential for transmission of disease remains undetermined since the number of organisms required to cause disease varies depending upon the organism, the host, and the manner in which the bacteria and host interact.

DISEASES CAUSED BY BACTERIA

There are several bacterial diseases associated with sewage wastes which are commonly found in the U.S. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are some of the most frequently applied indicators of water quality. The coliform group is made up of a number of bacteria including the genera Klebsiella, Escherichia, Serratia, Erwinia and Enterobacteria. Salmonella bacteria are responsible for several diseases including typhoid, paratyphoid and salmonellosis. These diseases are characterized by diarrhea, abdominal pain and vomiting, and are transmitted by fecal contamination of food or water. Gastroenteritis (food poisoning) is caused by Salmonella typhimurium which is transmitted by ingestion of contaminated food or water. Many animals are normally infected with salmonella, and may have these organisms in their nest, eggs or feces. Rodents are among these, and should be controlled at land treatment sites. Although the incidence of typhoid fever has decreased in the U.S., the incidence of other Salmonella infections has increased dramatically.

Shigellae is a group of bacteria which cause intestinal disease in man. It spreads rapidly under improper sanitary conditions and can be transmitted by flies.

E. coli are involved in waterborne enteric disease which cause mild to severe cholera-like symptoms in the small intestine, and diarrhea.

DISEASES CAUSED BY VIRUS

More than 100 strains of viruses may be present in the intestines of man and animals, and thus viruses find their way into wastewater. The viruses of particular interest to the waste treatment field are the enteric (digestive system) viruses: poliovirus, coxsackie-virus, echovirus, reovirus and hepatitus virus. These produce various diseases including aseptic meningitis, myocarditis, respiratory disease and gastrointestinal upset. The role of water in the transmission of those agents is not clear as yet.

Infectious hepatitus is spread through the fecal-oral route. It is a disease of the liver and recovery is complete in over 85% of cases (Jawetz, et al. 1974). However, it is a major public health problem worldwide where sudden epidemics occur as a result of fecal contamination of drinking water or food. Consumption of shellfish from sewage contaminated waters also accounts for outbreaks of hepatitus. This virus is quite resistant to heat, acid and chemical treatment. Proper sewage treatment and handling are necessary to control the organisms responsible for hepatitus.

DISEASES CAUSED BY PROTOZOANS

The most common pathogenic protozoan of interest to waste management is Entamoeba histolytica which causes amebic dysentery. This pathogen cannot exist in its active form outside of its host. However, it is capable of forming cysts which are excreted. These resistant cysts protect the protozoan from adverse environmental conditions outside the host. These cysts may also resist waste treatment processes and are capable of causing disease when ingested with contaminated food or water.

Giardiasis lamblia is an intestinal disease produced by infection of the gut. The parasite produces cysts that are spread to other hosts through fecal contamination. This disease has only recently been recognized in the U.S. and has been associated with drinking water contamination.

DISEASES CAUSED BY HELMINTHS

Tapeworms, roundworms and flukes are helminths which parasitize humans and which are associated with improperly handled sewage wastes. In the U.S., the Diphyllabothrium latum (a tapeworm) is most common, and preventing feces from reaching open water is important in controlling this pathogen. Several roundworms infect man, and the intestinal roundworm (Ascaris lumbriocoides) and the hookworm (Necator americanus) are both transmitted by improper treatment of sewage. Young Ascaris are not hardy and can be destroyed by cold or dessication. Hookworm eggs, however, hatch after they reach a soil environment and the young may live up to 6 months in the soil if it is cool and moist. Hookworm is common in the southern U.S.

It should be noted that the presence of pathogens in sewage or sludge does not necessarily imply infection. A single unit of most infectious agents almost never produces infection - substantial probabilities of infection are associated only with substantial numbers of biologic units. If infection does occur the likelihood that disease will result depends on the virulence of the agent and numerous other environmental factors that all have to combine together to provide an environment in which disease occurs.

CHEMICAL CONSTITUENTS THAT AFFECT ENVIRONMENTAL HEALTH

Chemical constituents, both organic and inorganic, form the second major category of wastewater constituents that may have an impact on human health. Their sources include industrial, residential and agricultural wastes. Health implications of their presence in water are known for only a few.

- Inorganic Chemicals

Inorganic chemicals found in water that appear to affect health are arsenic, cadmium, cyanide, flouride, lead, mercury and nitrate. These chemicals can affect human health in the following manner:

- Arsenic is common in nature and is present in water in relatively high concentrations. The symptoms of chronic arsenic poisoning are fatigue and lack of energy.

- Cadmium is normally present at very low levels in surface and groundwater. The human intake of cadmium has been attributed to various ailments, including renal dysfunction and hypertension and symptoms similar to food poisoning.

- Cyanide is used in industrial activities and may enter surface water and groundwater. When ingested, cyanide interferes with the body's oxygen transport system causing illness or death.

- Flouride is a naturally occurring mineral in water. Excess flouride can cause dental flourosis and in increased doses can cause bone changes including crippling flourosis.

- Lead occurs in water primarily from industrial and domestic activity. Lead poisoning is a chronic disease that can produce a variety of symptoms including anorexia, nausea, vomiting, paralysis, mental confusion, visual problems, and anemia.

- Mercury is found in both surface and ground water. Chronic poisoning is normally associated with industrial exposure particularly to mercury fumes. Mercury can accumulate in the body and chronic exposure can produce inflamation of the mouth and gums, swelling of salivary glands, loosening of teeth, kidney damage, and personality changes.

- Nitrates may enter water from various sources -- natural, agricultural, industrial, and domestic. Serious, sometimes fatal poisoning in infants has occurred following ingestion of water that contains nitrates. In this disease (methemoglobinemia) nitrate is reduced to nitrite which in turn seriously imparts the oxygen carrying capacity of the blood.

- Nitrosamines

These are present in soils and have been detected in sludge. It is speculated that they may be formed in the activated sludge process. Nitrosamines are known to be potent carcinogens (Ayanaba 1973, 1974).

- Barium enters the body primarily through air and water, since appreciable amounts are not contained in foods (NAS 1974). Ingestion of soluble barium compounds may result in effects on the gastrointestinal tract causing vomiting and diarrhea, and on the central nervous system, causing violent spasms.

- Chromium is found rarely in natural waters, but [illegible]und in air, soil, some foods, and most biological systems. It is recogniz[illegible] as an essential trace element for humans. Symptoms of excessive dietary intake of chromium in man are unknown, and chromium deficiency is of greater nutritional concern than overexposure.

- Iron is an essential trace element required by both plants and animals, is common in many rocks, is an important component of many soils and may be present in water in varying quantities. Prime iron pollution sources are industrial wastes, mine drainage waters and iron-bearing groundwaters. Iron affects the taste of water and may stain laundry plumbing fixtures. Iron can have a direct effect on the recreational use of water other than its effects on aquatic life. Suspended iron precipitates may interfere with swimming and be aesthetically objectionable due to yellow ochre or reddish iron oxide deposits.

- Manganese is found in various salts and minerals although it does not occur naturally as a metal. Manganese is a vital nutrient for both plants and animals, and is normally ingested as a trace nutrient in food. Very large doses of manganese can cause some disease and liver damage; however, these are not known to have occurred in the U.S.

- Polychlorinated Biphenyls (PCB's) - PCB compounds are slightly soluble in water and are resistant to both heat and biological degradation. They are used principally in the electrical industry in capacitators and transformers. The acute and chronic effects of PCB's have been determined on a number of aquatic organisms and birds. Exposure to PCB's is known to cause skin lesions in humans and to increase liver enzyme activity that may have a secondary effect on reproductive processes.

- Zinc is an essential and beneficial element in human metabolism and defininciencies of zinc in children leads to growth retardation.

PATHOGEN SURVIVAL IN SOIL

The detention time of pathogens in soil is the most important factor in the destruction of these organisms. Initial reactions between pathogens in sludge and the soil matrix are physical entrapment and chemical absorption at the soil surface (McGauhey and Krone 1967). Bacterial pathogens appear to die back rapidly once in the soil matrix.

Both abiotic (non-living) and biotic (living) factors affect pathogen elimination from the soil. Abiotic factors include soil moisture, temperature, texture, aeration, and organic matter content. A major biotic factor is competition between the soil microbial population and the applied pathogens.

Pathogenic bacteria cannot reproduce in the soil and will slowly die off. Viruses cannot reproduce at all in soil, but may remain viable in soil for some time. Three factors are important in removing virus particulates in the soil matrix. Those are adsorption, attack by bacteria and natural die off.

The greatest threat posed by land application or DLD disposal occurs when pathogens are allowed to pass to the groundwater and thereby contaminate drinking water supplies because there was insufficient detention time for these organisms to be inactivated in the soil matrix.

In general, pathogens die off more quickly on vegetation than in the soil due to the lack of protection given by vegetation from ultra-violet radiation, dessication and temperature extremes.

AEROSOL TRANSMISSION OF PATHOGENS

Aerosol droplets may contain bacteria and/or viruses. The most direct means of infection by pathogenic aerosols is by inhalation.

A primary cause of bacterial destruction in aerosols is rapid dessication. The rate of die off of bacteria is a function of relative humidity, termperature, sunlight, and wind velocity. Bacterial aerosols may remain viable for several hours.

10.5 ENGLISH UNIT/METRIC UNIT CONVERSION FACTORS

ENGLISH UNIT/METRIC UNIT CONVERSION FACTORS

Multiply (English Units)		by	To obtain (Metric Units)	
ENGLISH UNIT	ABBREVIATION	CONVERSION	ABBREVIATION	METRIC UNIT
acre	ac	0.405	ha	hectares
acre - feet	ac ft	1233.5	cu m	cubic meters
British Thermal Unit	BTU	0.252	kg cal	kilogram - calories
British Thermal Unit/pound	BTU/lb	0.555	kg cal/kg	kilogram calories/kilogram
cubic feet/minute	cfm	0.028	cu m/min	cubic meters/minute
cubic feet/second	cfs	1.7	cu m/min	cubic meters/minute
cubic feet	cu ft	0.028	cu m	cubic meters
cubic feet	cu ft	28.32	l	liters
cubic inches	cu in	16.39	cu cm	cubic centimeters
degree Fahrenheit	F	0.555 (°F-32)*	°C	degree Centigrade
feet	ft	0.3040	m	meters
gallon	gal	3.785	l	liters
gallon/minute	gpm	0.0631	l/sec	liters/second
horsepower	hp	0.7457	kw	kilowatts
inches	in	2.54	cm	centimeters
inches of mercury	in Hg	0.03342	atm	atmospheres
pounds	lb	0.454	kg	kilograms
million gallons/day	mgd	3,785	cu m/day	cubic meters/day
mile	mi	1.609	km	kilometer
pound/square inch (gauge)	psig	(0.06805 psig + 1)*	atm	atmospheres (absolute)
square feet	sq ft	0.0929	sq m	square meters
square inches	sq in	6.452	sq cm	square centimeters
tons (short)	t	0.907	kkg	metric tons (1000 kilograms)
yard	y	0.9144	m	meters

*Actual conversion, not a multiplier

Source: McCandless, Lee C., and Robert B. Shaver. 1978. Assessment of coal cleaning technology: first annual report. US Environmental Protection Agency, Office of Research and Development, Industrial Environmental Research Laboratory, Research Triangle Park NC, EPA-600/7-78-150, 153 p.

*U.S. GOVERNMENT PRINTING OFFICE: 1981—775-